Electrical Review

THE PIONEER ELECTRICAL WEEKLY OF AMERICA.

VOL. XXXVIII. No. 8. NEW YORK, SATURDAY, FEBRUARY 23, 1901. ISSUED WEEKLY.

ELECTRICAL REVIEW

Park Row Building,
13-21 Park Row, New York.
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(Private branch exchange connecting all departments.)

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1612-1613 Marquette Building, Chicago.

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42 Old Broad Street, London, E. C.

Subscriptions to the
ELECTRICAL REVIEW.

One Year, United States and Canada, - - - $3.00
One Year, Foreign Countries, - - - - - - 5.00
Single Copies, each, - - - - - - - - .10
Copies can be supplied for only one year back at 25 cents each.

THE ART OF LECTURING.

There is often presented at meetings of engineering and technical societies the absurd spectacle of a man who knows something addressing a number of people who want to be instructed, and yet not being able to make himself intelligible or to find a medium whereby to transmit his knowledge into their minds. In other words, the art of lecturing has fallen into serious decay with engineers and men of science, and only a few of the present generation, in this country at least, have the happy faculty of expressing themselves clearly and understandingly upon subjects on which they are expert.

One such man as Tyndall does more for science in his generation than a host of teachers who deal in terms that only a favored few can understand. The reading of a paper before such a body as the American Institute of Electrical Engineers, for example, is an opportunity of a high character, but the delivery of a lecture before a considerable number of intelligent people, not specialists in the lecturer's own department of knowledge, is an even greater opportunity for the dissemination of knowledge and the production of good results to all concerned. We have in the ranks of American workers in electricity many men whose knowledge is such that they might well instruct the public, and in this way accomplish a result enormously to be desired. But in nearly every case, coupled with this knowledge, is an unfortunate inability to make use of it for the purpose. It seems reasonable, therefore, to hope that the art of telling what one knows may hereafter be taught. The schools fall short of their duty when they teach a man the basis of a science or an art and fill him with information concerning it, and then leave him bottled up, as it were, with no ability to uncork himself and pour forth the treasures of his accumulated wisdom. All of us have sat through weary and unprofitable hours listening to people who might greatly have instructed us and greatly benefited us if they had only known how. The matter is one of real importance and should be given more attention than it has received during the last decade or two.

The Cocks and Doughty bill for regulating the speed of automobiles is now in the hands of the New York Legislature. The bill was conceived for the purpose of preventing the driving of automobiles at excessive speeds on Long Island roads, and if put into effect will, it is hoped, greatly diminish the number of accidents resultant upon such speeding.

A PRIZE OFFER OF ONE HUNDRED DOLLARS.

The ELECTRICAL REVIEW desires to publish an article upon the electric lighting central station superintendent—his duties, how he may best fit himself for them, what steps he must take to insure success in that profession, and what type of man is best fitted by character, experience, education and brain texture for employment under conditions of great responsibility by owners of such installations.

In order to secure the best views on this subject the ELECTRICAL REVIEW offers a prize of $100 for the best article of not less than three thousand nor more than five thousand words in length received at its office before May 1, 1901. To insure merit and restrict competition within reasonable bounds, only articles written by members or associate members of the American Institute of Electrical Engineers or members of the National Electric Light Association will be considered. It is believed that the prize article will be one of high value and importance to a large proportion of engineers and those financially or otherwise interested in the great industry of electric lighting.

In selecting the prize winner from the articles submitted the editorial staff of the ELECTRICAL REVIEW will be assisted by Mr. C. L. Edgar, president of the Edison Electric Illuminating Company of Boston; Mr. Charles R. Huntley, general manager of the Buffalo General Electric Company, of Buffalo, N. Y., and Mr. Alden M. Young, vice-president of the Kings County Electric Light and Power Company, of Brooklyn, N. Y. It is expected that the prize article will be published in May, 1901, in the ELECTRICAL REVIEW. Manuscripts accompanied by stamps for the purpose will be returned after the close of the competition.

ELECTRICAL SUBURBAN RAILWAY SERVICE FOR NEW YORK CITY.

It has just been announced that the New York Central & Hudson River Railroad has practically decided to use electricity as the motive power for its suburban service. For some time past this railway has been experimenting with compressed air and hot water motors, but it is now stated that the results obtained were not satisfactory. The third-rail system is said to be occupying the serious attention of the engineering department, and it is believed that it will ultimately be adopted by the company for its service of local trains.

There is no place in the world, with the possible exception of the old underground railway in London, that is so ready for electrical equipment as the tunnels used by this railroad in reaching its terminus in New York city. With increasing traffic the nuisance of foul gases and smoke in these tunnels has increased, until it has reached such a point that the ride in the tunnel is exceedingly distressing. It is even possible that an accident in the tunnel might result in serious consequences for passengers.

While electric traction as applied to suburban service of this one railway will not fully abate this difficulty, it will certainly present to the managements of the railroads that use the long tunnel on Fourth avenue in New York city, an object-lesson that they can not fail to misunderstand. It is the first step in the direction of proper operation of this important terminal.

The suburban system in question consists of three branches: one along the main line of the railway on the east bank of the Hudson River; another going up the next valley parallel to that of the Hudson and some miles further to the eastward; and a cross-over branch between the two, terminating at Yonkers as its northerly extremity. What part of the system would be equipped is not stated in the information that is at hand, but it is certain that the important Yonkers local service will receive early attention. Now that the electrical equipment of the elevated railway system in New York city is to be undertaken it is really necessary that the equipment should be extended to this line, which is virtually a prolongation northward of the West Side elevated lines. It is greatly to be hoped that work will be begun at once and that we shall soon enjoy at least one suburban system operated in a modern and approved way.

New York city, on account of its situation, surrounded by deep water-ways, presents a difficult problem to engineers undertaking to better suburban transportation service to and from it. And the problem is much complicated by the fact that lines coming in from the West and South must transfer passengers to ferryboats, and that lines coming in from the East and points on Long Island must do the same thing, or else transfer passengers to cars crossing the already congested and overcrowded bridge. The lines from the North, however, enter Manhattan Island directly, and here is an admirable opportunity to show the excellence of electric service for this particular variety of transportation. It is much to be hoped that in the new equipment there will be some departure from traditional methods. The full advantages of an electrical suburban system can only be secured when the extraordinary flexibility of an electrical equipment is made evident. The substitution of electrical locomotives for steam locomotives will be a considerable betterment, but by no means will this simple change accomplish all of the desirable ends that can be brought about by the adoption of electric motive-power. With the crowded traffic that suburban lines entering a great city enjoy, and with the peculiar distribution of the traffic into two "rush periods," morning and evening, with comparatively little travel at other times, some variety of the multiple-unit system is evidently necessary to secure the best results. It is to be hoped that the management of the New York Central Railroad will consider the subject in the light of recent experience and avail itself of the best advice that can be had, so that the new system when installed shall be satisfactory in all its details and such a one as the Metropolis of the United States ought to enjoy, and worthy of the reputation of this excellent railway.

A HINT TO THE EXPORTER.

Export trade between the United States and foreign countries has grown to such enormous proportions within the last fifty years that it is of cardinal importance for our manufacturers to apprehend fully the situation and make every effort, not only to hold their own, but to place themselves in such a position that it will be impossible for any competitor to undermine the stable foundation already set up.

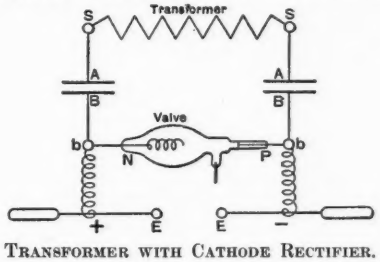
Trade with Mexico in the export business has never been as brisk, considering the size of the country, as it has been with other nations. This may be assigned to two reasons, one of which is the lack of development, and the other, and more important, the fact that American exporters have not always been judicious in attempting to push trade there. A Mexican is primarily not an experimenter. If his hacienda is making a reasonable living for him, or if his factory pays a moderate dividend at stated intervals, he is more than likely to be very well content. He is unlikely to seek improvements and incur expense when he can not see that such a course would net him a positive number of dollars and cents within a given time. Unacquainted with modern electrical methods, as the natives of interior Mexico are, to a great extent, and unfamiliar with the standing of our firms and the superiority of our machinery, it is not to be wondered at that mere advertisements in local papers, and circulars mailed to the various men interested, fail to secure any large amount of trade. It remains for the manufacturer to be personally represented. His agent must lay before the possible purchaser a concise and authoritative statement of the value and utility of his production; he must be acquainted with the customs of the country; and he must have sufficient confidence to be willing to meet the prevailing stringency in the money market with terms suited to the particular requirements of each individual case. While money may not be the main consideration in the first instance, it is in the end, and it therefore behooves the manufacturer to spend money, lavishly if need be, in order to make it come back to him. He must sow where he expects to reap.

Science Brevities

Tempering of Overstrained Iron—It is well known that iron hardened by overstrain, such as permanent stretching, may have its original properties restored by annealing. Experiments made by James Muir show, however, says the *Electrician,* that if iron hardened by overstrain be raised to any temperature above 300 degrees, it may be partially softened in a manner analogous to the ordinary tempering or "letting down" of steel which has been hardened by quenching from a red heat. This tempering from a condition of hardness induced by overstrain, unlike ordinary tempering, is applicable not only to steel, but also to wrought iron, and possibly to other materials which can be hardened by overstrain and softened by annealing. In the author's experiments, the straining was performed by means of a 50-ton testing machine. A rod of semi-mild steel showed a yield point at about 38 tons per square inch to start with. After overstraining it and laying it aside for one and three-quarter days, the specimen showed a marked recovery from strain, and after resting for two weeks the curve of strain was found to return nearly upon itself. A perfect restitution could be obtained at once by a few minutes' immersion in boiling water, or an exposure to a temperature of 200 degrees. At the same time the yield-point rose to 49 tons per square inch, and another similar operation even raised it to 60 tons.

Luminosity of Gases—Herr J. Stark, in continuing his researches on the luminosity of gases under electric discharge, has arrived at some interesting general conclusions. One of Mr. Fournier d'Albe's abstracts says: Luminosity is due to the impact of ions upon each other and upon neutral molecules, the luminosity being greater in the former than in the latter case. The greatest amount of luminous energy is evolved where the greatest number of encounters between positive and negative ions takes place—*i. e.,* at the points of maximum ionization. The gas itself sends out the luminous rays, and the process is intimately connected with the diffused reflection of cathode rays by solid bodies. In these encounters, the place of the solid bodies is occupied by the positive ions. It is in the luminous portions of the discharge that the kinetic energy of ions produced at the cathode is absorbed. The mean velocity of an ion depends not only upon its mean free path, but also upon the degree of ionization of the gas, for the mutual attraction of the ions brings about a greater number of encounters than would otherwise take place. Luminosity is produced not only by the primary cathode rays, but also by the secondary ones, and, indeed, at a greater number of points by the latter, since, owing to their smaller velocity, they are diverted and dispersed to a greater extent by the positive ions.

Transformer with Cathode Rectifier—M. P. Villard describes a new high-voltage transformer in which one of the alternations is suppressed by means of a cathode-ray valve, which, as we know, possesses at a certain exhaustion a resistance capable of opposing 60,000 volts in one direction (when the wire coil is the anode), and a very feeble resistance to a current in the opposite direction, says an *Electrician* abstract. The circuit is interrupted by condensers at A′, B, A, B′, as in Tesla's arrangement, and the valve is inserted between *b* and *b′*. It contains a small rod of platinum in a side tube, which is heated to liberate the necessary amount of hydrogen. The same transformer may be made to feed two exciters, and there is a greatly increased voltage in the circuit.



TRANSFORMER WITH CATHODE RECTIFIER.

Impedance of Iron Conductors—Herren C. Feldmann and J. Herzog, writing in the *Elektrotechnische Zeitschrift,* after referring to the work of Rayleigh and Kelvin on the distribution of an alternating current over the cross-section of a conductor, point out that the series given by these writers for the equivalent resistance of the conductor are very slowly convergent when the permeability has a high value, and that it is more convenient in such cases to have recourse to the formulæ of J. J. Thomson, for the actual magnetic intensity at any point of a lamina of iron which is subjected to an alternating impressed magnetic field. These formulæ will apply to the distribution of an alternating current over the cross-section of a lamina, and it is convenient to determine the depth of the effective surface layer which represents the equivalent resistance. Curves are given for this depth corresponding to different thicknesses of the lamina and different frequencies. The authors give the results of some experimental determinations of the impedance for iron conductors of various forms of cross-section. The subject is of importance in connection with polyphase systems of electric traction using a rail return. An account of some further experiments with steel rails is given, which shows that the impedance varies considerably with the shape of the potential difference wave, a peaked wave producing a much higher impedance than a sine wave. Wattmeter measurements showed that the power factor was in all cases in the neighborhood of 0.8. The authors point out that with alternating currents the efficiency of rail-bonds is relatively less important, on account of the greatly increased impedance of the rails; the experiments alluded to above showing that with a frequency of 42 the impedance was 5.25 times, and with a frequency of 15, 3.6 times, the resistance to continuous currents. The importance of using the lowest practicable frequency in connection with traction systems is sufficiently obvious.

White Lead Production by Electricity—Mr. E. Bailey, residing in York, England, has invented a means of producing white lead and other metallic compounds by electricity. This is done by the use of the electric arc, the lead to be treated being kept in a molten state. The metal is acted upon by gaseous vapors, which produce carbonate of lead or any other required lead compound. The fumes produced are blown over into chambers having canvas or fine fabric cloth covers or roofs. The fine dry powdered white lead falls down and the uncondensable gases pass through the fine canvas roof, thus dispensing with grinding, washing and drying processes. It is claimed that there will be at least a saving of 50 per cent in production by this process, says the London *Electrical Engineer.*

Treatment of Epidermoid Cancer by X-Rays—Dr. Francis H. Williams says that his experience at the Boston City Hospital indicates that we have either in the X-rays themselves or in some other form of radiation from an excited Crookes tube a valuable therapeutic agent in epithelioma, and that the beneficent action of the X-rays can be brought about without causing a burn. Foul and nearly unbearable odors cease, the discharge becomes less, and the growth steadily diminishes in size. The earlier this treatment is undertaken the better. It is not improbable that we shall find its curative action limited to superficial growths, though as a means of relieving the painful features of the disease in other forms it may be of some use.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XVI.

BY W. ELWELL GOLDSBOROUGH.

ON SERIES CIRCUITS CONTAINING RESISTANCE, INDUCTANCE AND CAPACITY.

It frequently happens in alternate-current working that it becomes necessary to deal with systems of simple circuits connected in series.

The treatment so far given is hardly sufficiently developed to admit of its being comprehensively applied to such systems without further amplification. We can, then, profitably study such a system of circuits as is represented by the diagram shown in Fig. 41.

In Fig. 41 the section (AB) represents a simple circuit having a line resistance equal to (r_1) and an effective inductive reactance equal to (x_1). The section (BC) of the system represents another simple circuit, the resistance of which is r_2 and the reactance of which is x_2 due to the effective capacity at c_2. The third section (CD) is, like (AB), an inductive circuit of reactance x_3 and resistance r_3.

If an electro-motive force is impressed upon this system from the alternator at E, a current will be made to flow through the system and the same current will be set up in all three circuits. The current flowing in each of the circuits will of necessity, then, be in phase with the current flowing in each of the other two circuits, and, consequently, the ohmic electro-motive forces active in the circuits will be in phase with the current and with one another. Moreover, the electro-motive forces which are active in each of the simple circuits in overcoming the electro-motive forces induced in the induction coils and the condenser by the current are displaced in phase, as regards the current, by angles of 90°.

In view of these facts we have sufficient data at hand to construct a vector diagram that will exhibit the relative magnitude and phase relation of all the factors involved. To do this we first lay off the vector (AK) equal in value to the current. Then, in phase with the current and from the point (A), the ohmic electro-motive force of the first circuit (AB) is laid off equal to $I\ r_1 = AH$. From the point (H) and in a direction 90° in advance of the current the reactive electro-motive force of the first circuit is laid off equal to $I\ x_1 = IL\ 2\ \pi\ N = HB$. This electro-motive force is laid off in advance of the current for the reason that it overcomes the counter electro-motive force of the induction coil, which, as is explained on page 596, volume 37, lags 90° behind the current. Now, by joining (A) and (B) we get the vector (AB), the length of which, in terms of the units chosen in laying off (AH), is equal to the electro-motive force that is necessary to set up the current (I) in the circuit (AB).

To determine the relative magnitude and position of the vectors which show the values of the electro-motive forces acting in the second circuit we build up a second triangle, taking this time the point (B) as the initial vector point of the ohmic electro-motive force of the second circuit. This ohmic electro-motive-force vector must be laid off from (B) in a direction that is parallel to the current vector (AK) and must be equal in length to $I\ r_2 = B1$ of Fig. 42. Again, since the reactance of the second circuit is due to capacity in the circuit, the phase of the reactance electro-motive-force vector of

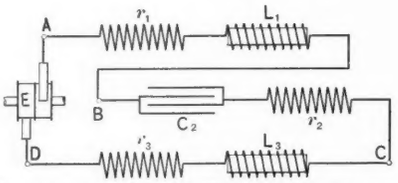


FIG. 41 —ALTERNATING-CURRENT MECHANISMS.

this circuit will be displaced 180° from the phase position of the vector (HB), since the effect of a reactance due to capacity in the line is diametrically opposed to any inductive reactance that may be present. The reactance electro-motive force of the second circuit must, then, be laid off lagging 90° behind the circuit from the point I and equal in value to

$$I\ x_2 = \frac{I}{C\ 2\ \pi\ N} = IC.$$

The phase position and value of the electro-motive force impressed upon the second circuit are now determined, as, by joining the points (B) and (C), the vector (B C) is determined, which, by its length and position, evaluates this electro-motive force.

The third circuit being a highly inductive one is treated in the same manner as the first. The vector $CJ = I\ r_3$ is equal to the ohmic electro-motive force of the circuit, and the vector (JD), 90° in advance of (JD), and equal to $I\ x_3 = IL\ 2\ \pi\ N$, is the reactive electro-motive force of the circuit. Therefore connecting the points (C) and (D) we have the phase position and value of the electro-motive force acting on the third circuit.

The vectors (AB), (BC) and (CD) are the three main components of the electro-motive force impressed by the alternator on the system, and this electro-motive force of the alternator is the vector sum of the three components. That this is mathematically a correct statement has already been demonstrated on page 509, volume xxxvii. Therefore, and finally, the impressed electro-motive force is equal to the line (AD); the length of (AD) is equal to its numerical value, while the slant of (AD), taken with reference to the current vector, gives its phase angle.

In this case the values involved are such that the impressed electro-motive force is in advance of the current. To all intents and purposes, then, the system considered as a whole is an inductive one, having a total effective inductance $x = x_2 - (x_1 + x_3)$, for since all of the reactive electro-motive forces are shown to be in phase with one another the reactances are also in phase with one another, and the effective reactance of the system is equal to the sum of the several local reactances taken with proper reference to sign.

The total non-inductive resistance of the system is likewise equal to the sum of the several line resistances of the several circuits, or $r = r_1 + r_2 + r_3$, for since all of the ohmic electro-motive forces are in phase with one another and acting together in series, the resistances which give rise to these electro-motive forces are added directly in determining the equivalent or effective non-inductive resistance of the whole system.

To bring out these facts stronger we can construct the impedance diagram of the system by reducing the vectors of Fig. 42. Divide all the voltage values by the current and express the resulting quotient vector values in ohms.

In Fig. 43 is shown this impedance diagram. In it the vector $a\ h = AH \div I = r_1$, the vector $h\ b = HB \div I = L_1\ \omega = x_1$, and the vector $a\ b = AB \div I = E_1 \div I_1 = z_1$. In like manner in the other impedance vector triangles, $b\ i\ c$ and $c\ j\ d$, $b\ i = r_2$, $c\ j = r_3$, $i\ c = x_2$, $j\ d = x_3$, $b\ c = z_2$ and $c\ d = z_3$. It follows, then, directly that $a\ d = AD \div I = E \div I = z$, or that the impedance of the system is equal to the vector sum of the impedances of the component circuits.

A consideration of these facts puts us in a position to formulate definite rules for the equivalent resistance, reactance and impedance of systems of circuits connected in series, therefore it may be stated that,

The joint resistance of any number of circuits connected in series is equal to the arithmetic sum of the resistances of the individual circuits.

The joint inductive reactance of any number of circuits connected in series is equal to the arithmetic sum of the inductive reactances of the individual circuits.

The joint reactance due to capacity alone of any number of circuits connected in series is equal to the arithmetic sum of

the reactances due to the capacities of the individual circuits.

The joint reactance of any number of circuits connected in series is equal to the algebraic sum of the reactances of the individual circuits, the inductive reactances being entered in the summation as negative quantities.

The joint impedance of any number of circuits connected in series is equal to the vector sum of the impedances of the individual circuits.

Example No. 8.

Given: A distributing system consisting of three electric circuits connected in series. Impressed upon the system is the electro-motive force of a single phase generator developing a vertical pressure of 98 volts at a frequency of 60 cycles. The first circuit has a line resistance of 2.5 ohms and an inductive reactance at 60 cycles of 1.67 ohms. The second circuit has a line resistance of 3.33 ohms and a reactance at 60 cycles, due to condenser effects in the circuit, of .83 ohm. The third circuit has a line resistance of 1.67 ohms, and the recurve in the line has an effective inductive reactance at 60 cycles of 2.5 ohms.

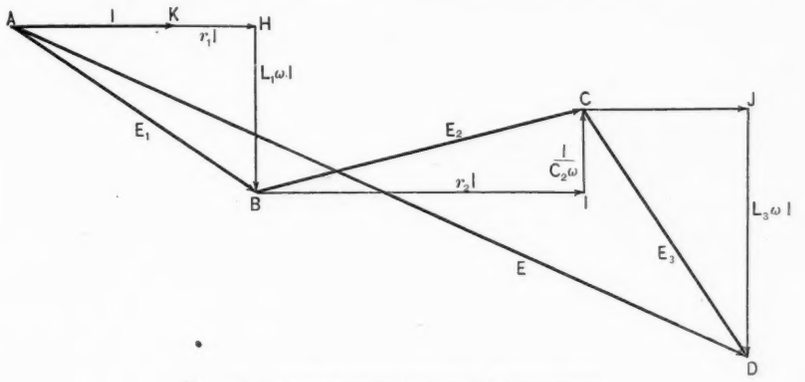


FIG. 42.—ALTERNATING-CURRENT MECHANISMS.

Determine by graphical methods the value of the current flowing in the system and the value of the phase angle between the impressed electro-motive force and this current.

In solving this problem we will refer to Fig. 43. In it lay off the line ($a\ h$) in any convenient units equal in length to the value of $r_1 = 2.5$ ohms. From the point (h) drop the line ($h\ b$) at right angles to ($a\ h$) and on it lay off the distance ($h\ b$) equal to $x_1 = 1.67$. Now join the points (a) and (b) by the line ($a\ b$) and measure its length. The line represents the impedance of the first circuit, and its length shows that $z_1 = 3$ ohms. Again, from the point (b) lay off the line ($b\ i$) parallel to the line ($a\ h$), and make the distance ($b\ i$) equal to $r_2 = 3.33$. Then at the point (i) erect the perpendicular ($i\ c$) to the line ($b\ i$) and make its length equal to the capacity reactance of the second circuit, $x_2 = .83$. The hypotenuse of the triangle ($b\ i\ c$) represents by its length the impedance of the second circuit, or $z_2 = 3.42$ ohms. To determine the value and phase position of the impedance vector of the third circuit lay off from the point (c) the line ($c\ j$) equal to $r_3 = 1.67$ and parallel to the line ($a\ h$), and at (j) let fall a perpendicular to the line ($c\ j$). Lay off on the perpendicular the distance ($j\ d$) equal to $x_3 = 2.5$ and thereby determine the position of the point (d). The impedance vector of the third circuit is determined by joining the points (c) and (d), and its length is $z_3 = 3$ ohms. The impedance vectors of the three circuits have now been determined, and are shown in the figure in their correct phase position. Therefore, applying the rule, the impedance of the system, taken as a whole, is equal to the vector sum of the several impedances of the component circuits, therefore it is equal to the vector ($a\ d$), equal to $z = 8.2$

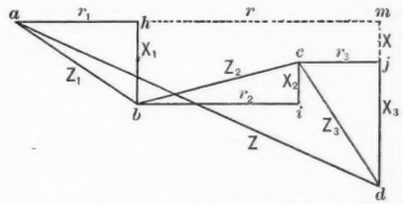


FIG. 43.—ALTERNATING-CURRENT MECHANISMS

ohms, since the vector ($a\ d$) is the resultant of the vectors ($a\ b$), ($b\ c$) and ($c\ d$). Now, therefore, to determine the value of the current flowing in the system, we have only to divide the impressed electro-motive force by the resultant impedance and obtain

$$I = \frac{E}{Z} = \frac{98}{8.2} =$$

12 virtual amperes in accordance with the formulas developed on page 596, volume xxxvii.

Just as the impedance diagram has been developed so can the electro-motive-force diagram for the system be developed. This can be accomplished either by increasing the length of each of the vectors of Fig. 43 in the ratio of Z to E, or of 8.2 to 98, or by multiplying the reactance constants of each of the circuits by the value of the current, I = 12, and then building up the diagram in the same manner as the diagram of Fig. 43 was produced. Either method gives the same result, and will produce the vector diagram shown in Fig. 42. This diagram shows that the electro-motive forces impressed on the first and third circuits are in advance of the current, but that the electro-motive force impressed on the second circuit lags behind the current. Also, that the electro-motive forces of the first and third circuits are in advance of the alternator impressed electro-motive force as well, and that the electro-motive force of the second circuit lags behind the alternator electro-motive force. Such a combination of phase relationships does not necessarily follow. They are peculiar to this system in view of its constants, and would vary as the constants were varied.

Finally, to determine the angle of lag of the current behind the alternator electro-motive force, the angle between the vectors (AD) and (AK) of Fig. 42 should be measured with a protractor. By such a determination it is found to be 24°.

In Fig. 42 (AH) = 30 volts, (HB) = 20 volts, (BI) = 40 volts, (IC) = 10 volts, (CJ) = 20 volts, (JD) = 30 volts, (AB) = 36 volts, (BC) = 41 volts and (CD) = 36 volts.

To Telegraph Over the Ocean.

[*From the Sun, New York, February 14, 1901.*]

The *Sun* is authorized to state that the plans for the machinery of wireless telegraphy to signal across the ocean have been completed and a site for the plant selected by Nikola Tesla, and that the project will at once be actively begun. It is estimated that the time required to perfect the apparatus will be about eight months.

We have received inquiries of late as to Mr. Tesla's place among inventors, and as to his credentials to fame. We don't know fully about those things, but we do know that it is Tesla who has given the world what is perhaps the most precious invention of the time, the electrical transmission of power, and we have seen the letter in which Professor Slaby, of Berlin, calls him the "father of wireless telegraphy."

Will his gorgeous vision, described above, be realized? We don't know. So we must let doubt and incredulity gnaw upon the bare statement.

The town of West Haven, Ct., has recently awarded its lighting contract, receiving a bid of $27.50 per lamp.

ELECTRIC LOCOMOTIVES.

SOME EXAMPLES OF AMERICAN AND EUROPEAN ELECTRIC LOCOMOTIVE CONSTRUCTION.

While the equipment of electric railroads has become one of the most important industries of the period, and while tramway and interurban lines have grown up in many parts of the world, it is only of late that the electric locomotive has been developed as an adjunct in factory and construction work as well as for the handling of trains either in switch-yards or on short lengths of railway where some peculiar service condition is imposed upon them.

As an example of the last-named variety Fig. 1 shows the working parts of an extraordinary locomotive recently constructed by Messrs. Brown, Boveri & Company, of Baden, Switzerland, for the railway company operating a rack road up a mountain in the suburbs of Lyons, France. The total equipment of the railway consists of six locomotives, four of which are of the type shown in the illustration and two of smaller power. The machine shown in the engraving is operated by direct current, a single motor of a multipolar type being used, and, as the illustration exhibits, geared directly to the pinion operating in the rack between the rails. The motor is shunt wound of 150 horse-power, and is equipped with a combination controller, switch and magnetic blow-out device. The controller includes rheostats in the shunt and armature circuits, lightning arresters, automatic circuit-breakers and electric braking apparatus.

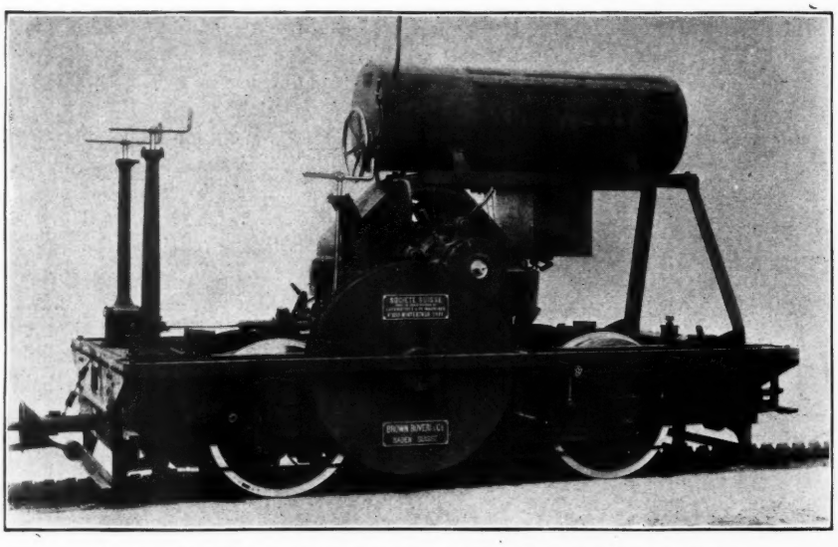


FIG. 1.—ELECTRIC LOCOMOTIVE FOR THE LYONS-ST. JUST RACK RAILWAY.

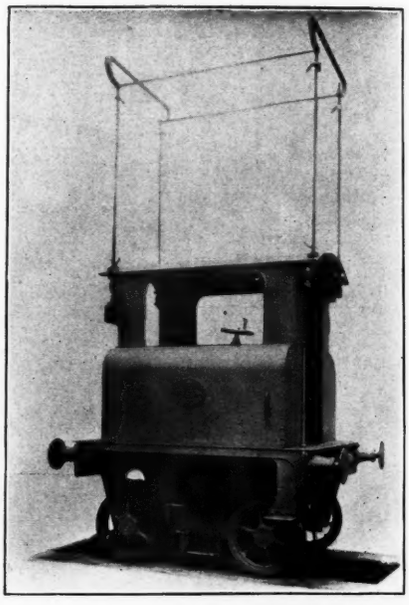


FIG. 2.—BRITISH SWITCHING LOCOMOTIVE.

In England considerable use has been found for electric locomotives in handling freight cars at large industrial works, where they are loaded or unloaded in the works yards. Figs. 2 and 3 exhibit two extraordinary types of locomotive made

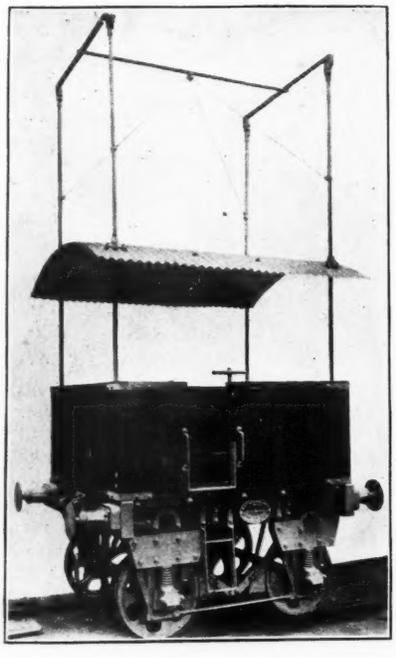


FIG. 3.—BRITISH SWITCHING LOCOMOTIVE.

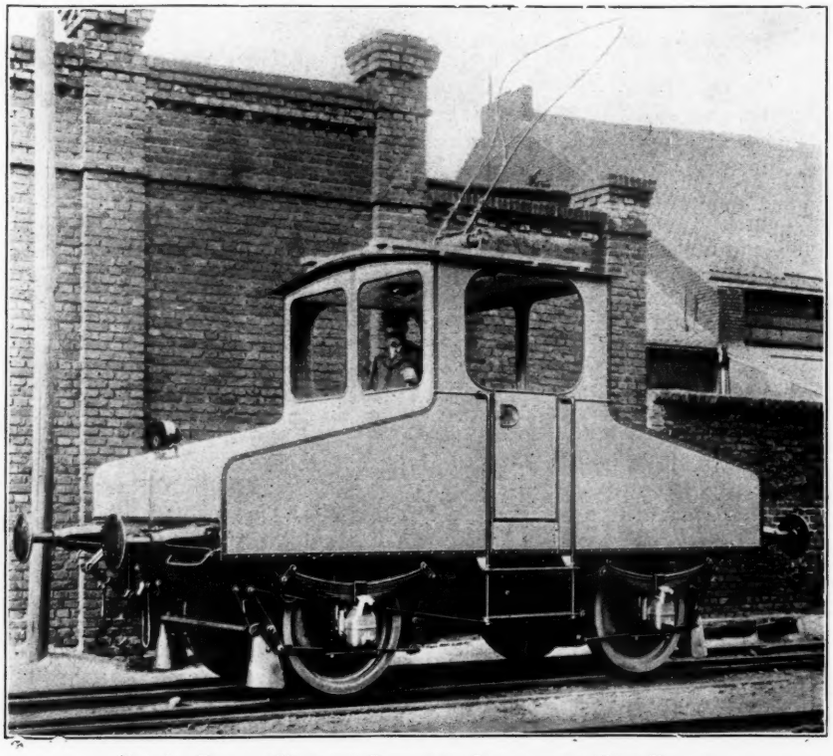


FIG. 4.—GERMAN ELECTRIC SWITCHING LOCOMOTIVE, HIGH POWER.

for this purpose by Messrs. Mather & Platt, Limited, of Manchester, England. These machines are built for a normal speed of only four and one-half miles per hour, the motor being geared to a countershaft from which power is taken to the wheels by a heavy sprocket chain. They are made to work on 300 to 330 volts pressure, the current collecting device being of an extremely peculiar nature. Two wrought-iron bars placed six feet apart in the structure at the top of the machine rub against the under surface of the trolley wire. These parts are, of course, carefully insulated from the roof of the cab of the machine. It is stated that these small locomotives will handle a 50-ton freight car with great ease.

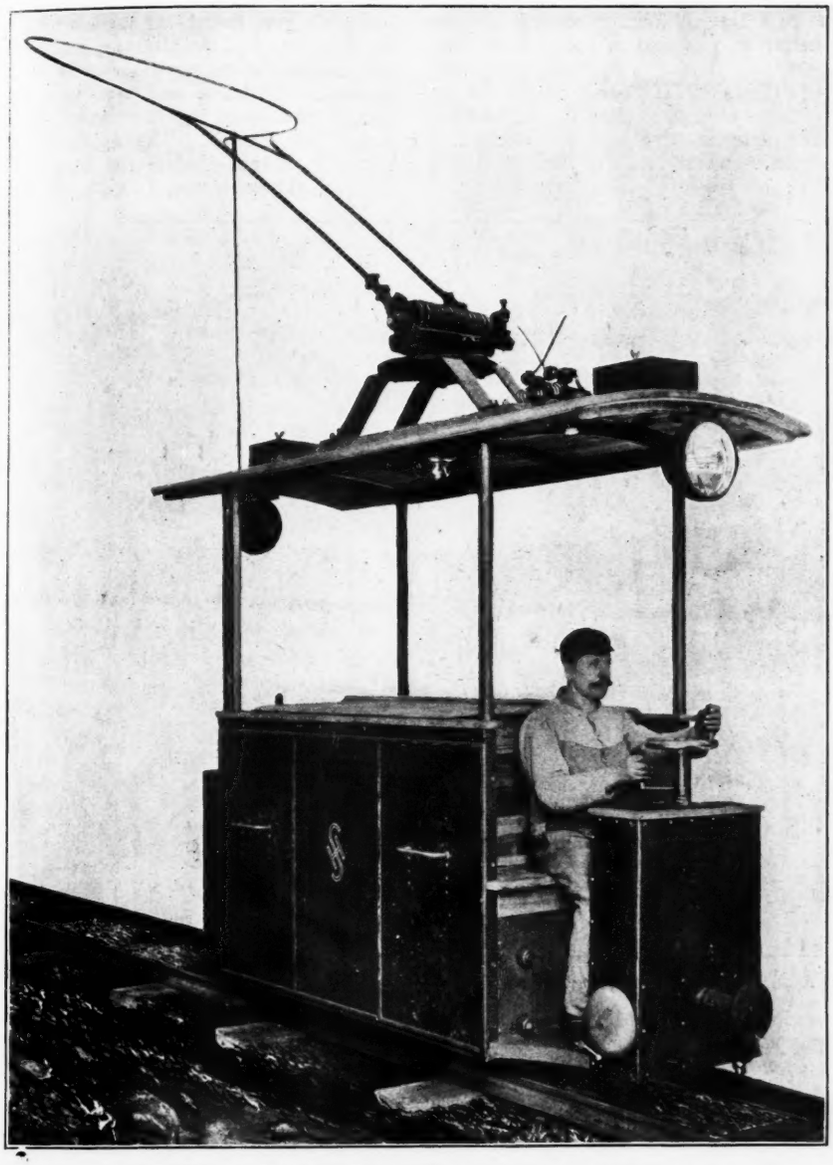


FIG. 5.—GERMAN ELECTRIC SWITCHING LOCOMOTIVE, NARROW GAUGE.

Figs. 4 and 5 illustrate two interesting types of electric locomotive for switching and yard hauling purposes, made by Messrs. Siemens & Halske, of Berlin, Germany. The bow-trolley, largely used in Europe for work of this class and on tramway lines, is well illustrated in these figures, and on the top of the smaller locomotive may be seen one of the curious blow-out lightning arresters used by the manufacturers.

Fig. 6 illustrates one of the most remarkable types of switching locomotives in use in Germany, this machine having also been built by Siemens & Halske. It derives its power from storage batteries carried on board. In the case of locomotives required principally for switching purposes over a complicated system of switch-points and cross-overs confined in a comparatively small space, the problem of a conducting system becomes exceedingly complicated and troublesome. No great power is required in such operations seeing that they are usually conducted at slow speed and where a convenient generating station exists accumulator driven locomotives have shown considerable advantage in operation for this purpose. It will be noticed that the locomotive illustrated has ample capacity for carrying a large number of storage cells and utilizes all of the weight thus added to that of its motors and running gear for traction purposes.

Figs. 7 and 8 represent switching locomotives of American make, these machines having been constructed by the Westinghouse and Baldwin companies, the former supplying the electrical equipment and the latter making the running gear and the other mechanical parts. Both of them are built for standard gauge railways. The smaller machine using the single trolley is a standard type of switching locomotive for situations requiring comparatively small power. The larger apparatus was built for the Imperial Lumber Company, and is a powerful machine intended for rather heavy freight service. It works on 500 volts direct current and carries four motors giving it a total starting draw-bar pull of 11,000 pounds, and a pull of 7,000 pounds while running at its maximum speed of 10 miles per hour. The drivers are 33 inches in diameter and are four in number, each truck having a wheel base of six feet, the total wheel base being 18 feet. The locomotive is 21 feet six inches long and weighs, all told, 54,700 pounds. It is provided with electric headlights and two trolleys to divide the heavy current taken from the trolley wire. The machine is equipped with Westinghouse air brakes and a compressed air whistle blown from the reservoir of air used for brake purposes.

Some Reminiscences of Early Electric Lighting.

TO THE EDITOR OF ELECTRICAL REVIEW:

I have read the Historical Number of the ELECTRICAL REVIEW with much interest, as it takes me back to the early days and calls to mind many occurrences not frequently remembered or given proper credit at present. Without any question the work of those early days, in the face of the conditions then existing, is deserving of the greatest credit to those who accomplished it.

In reading the different articles included in that issue I have noted a number of points which I would make mention of, as follows:

In the article on page 31, prophesying future developments, it seems to me that there is hardly prominence enough given to the probabilities of the utilization and distribution of Nature's stored energy in the form of coal, oil, gas, etc., by the locating of electric power plants at the points in the country where these are found, and converting them at those points into electrical energy and distributing the energy by means of high-potential, multiphase alternating currents. It seems to me that the tendencies are all leading towards the accomplishment of this step, as the success that has been attained in long-distance, high-tension transmission is such as opens up the greatest possibilities in this line; so it would seem to me

safe to predict that the next five or ten years will see most rapid and extensive developments in this line, which, if accomplished, will certainly be a far more scientific way of utilizing and distributing Nature's energy than the crude distribution in bulk form as now employed, and the inconvenient and uneconomical methods of utilization at destination.

In the article by Mr. Charles T. Child, I note in the third paragraph of third column on page 36 that no mention is made of the results accomplished by Hiram S. Maxim in the development of the incandescent lamp, which results are a matter of record, and were unquestionably of great value in the development; as, for instance, the hydro-carbon treatment of the carbon filaments, which was employed from the very first by Maxim and which was ridiculed and called impractical by other incandescent lamp manufacturers, is to-day universally used, and without it there is no question but what the incandescent lamp would not be manufactured as uniformly and correctly and at as low a price as by its aid. This is but one of many pioneer improvements introduced by Maxim and for which he should be given credit.

Further, in said article, on page 37, where mention is made of the recognized limitations of direct-current systems, and credit is given to those pioneers who took up the alternating-current system with such vigor and determined purpose as has resulted in its present leadership, no credit is given to William Stanley, who, I think, is entitled to great credit for having introduced the alternating-current system into this country, and who was the first, after the single-phase system had reached its limitations, to develop and put into practical operation the multiphase system, of any of the workers in that field; and while those who know him realize that his modesty has never led him to seek popularity in what he has accomplished, yet his works should speak for themselves, and he should consequently be accorded the credit which is certainly due him.

In the mention of the early work accomplished in electric railroading, I see no record or mention of the fact that the Siemens & Halske Company exhibited at the first International Electrical Exposition, which was held in Paris in the Fall of 1881, and had in operation from the the Palais de L'Industrie, where the exposition was held, to the Place de La Concorde, a trolley line with one car, which worked very satisfactorily throughout the whole of the exposition, which continued for several months. The car was equipped with a motor which was belted or connected by rope-drive to the axles, and fed by current from two slotted tubes, supported at one side of and slightly above the car from poles, along the under side of which slotted tubes ran a carrier which made connection with the tubes by means of metal connections. These extended from the carrier through the slots and terminated inside the tubes in ball ends which permitted the carrier to slide lengthwise, but not to fall away from the tubes. This carrier was connected with the car by means of a flexible cable. While in a number of respects a crude outfit from our present standpoint, the practical success and reliable operation accomplished with that car are certainly worthy of mention.

In Mr. Edison's reminiscences, I note that in the second column on page 61, he mentions January, 1880, as the date when the board of aldermen of New York city went to Menlo Park on a special train to see the Edison incandescent lights which he then had on exhibition, and which were arranged outdoors in lines like streets, controlled from within the laboratory, and he further mentions that he remembers that Hiram Maxim was at this exhibition. I think Mr. Edison is mistaken both as to the date and as to Mr. Maxim's presence, as I think in January, 1880, the *first experiments* were then being made with carbon filaments, and the platinum lamp with the thermostatic regulator was then largely in evidence, and was then frequently mentioned in the columns of the New York *Herald*. The exhibition at Menlo Park made before the New York board of aldermen was, I think, made in January, 1881, as the writer had the pleasure of making the trip with the New York aldermen, and knows that Mr. Maxim was not present on the train or at Menlo Park that evening. The difference is but a year, but a year in those days was to the progress of electric lighting more than many years at the present rate of progress. A further check as to the correctness of my remembrance in the matter of dates can be obtained by looking up the date when the first Edison isolated plant was installed in New York city, it having been, I believe, installed in the Label Printing Works of Hines, Ketchum & Company, somewhere on the East Side; this installation was made, I believe, during the Winter of 1880-81, which was subsequent to the service installed by the United States Electric Lighting Company (both isolated plant and central station service) which

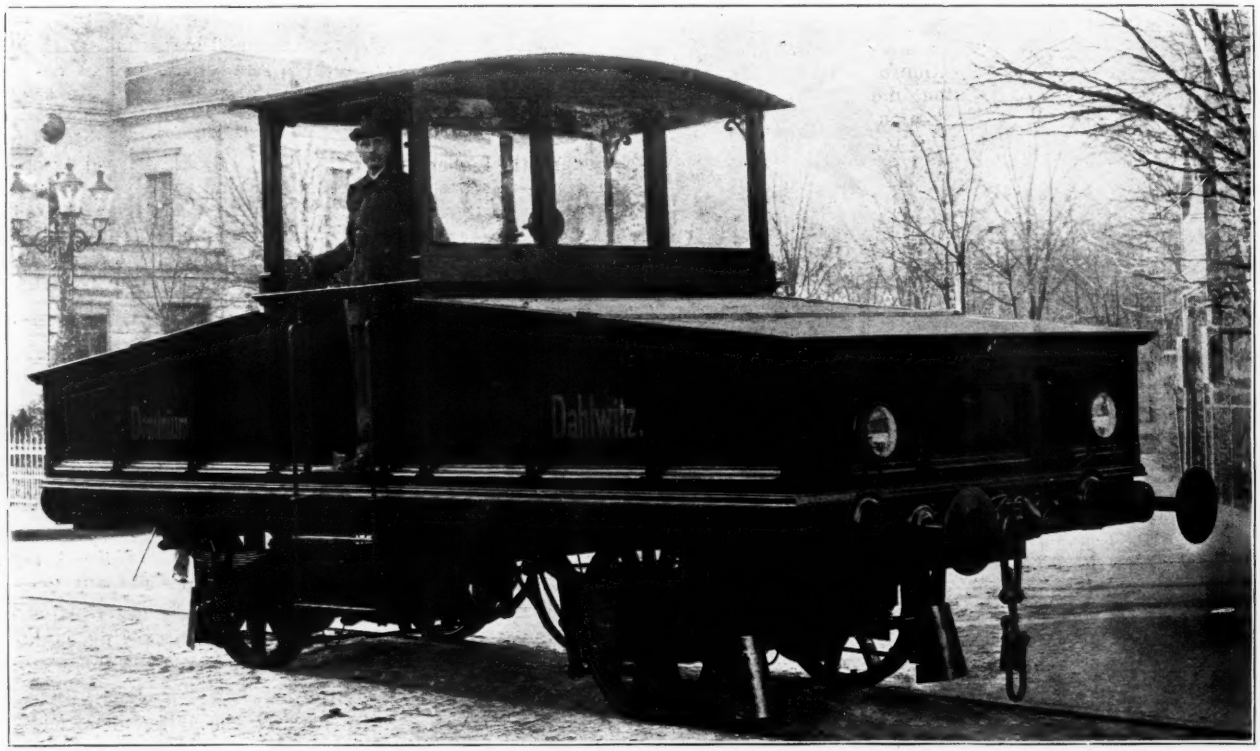


FIG. 6.—GERMAN ACCUMULATOR LOCOMOTIVE FOR SWITCHING FREIGHT CARS.

was done in 1880, as stated by George W. Hebard on page 77. The very first places lighted by central station service were the banking house of Fisk & Hatch on Nassau street, opposite the Treasury Building, and Hatch & Foote on Wall street; those two places having been connected with the plant in the basement of the Equitable Building, during the Fall of 1880—at which time no other lights were, or had been, operated in New York city from machines located in blocks separate from the one where the lights were used.

I would mention the fact that the incandescent lamps first manufactured had an efficiency of probably no better than about six watts per candle, or, approximately, 125 to 130 candles per horse-power; while at present, our three-watt lamps give about 250 candles per horse-power and two and one-half watts, 300 candles per horse-power. As evidencing the further room there is for improvement in incandescent lamps, I have but to mention that during the Paris Exposition of 1881 I assisted Professors Ayrton and Perry in testing some of the Maxim incandescent lamps I had on exhibition there, and by actual photometric test obtained at that time 1,410 candles from one of said lamps, at which candle-power we obtained over 1,200 candles per horse-power; in other words, over four times the light per horse-power that is obtained from our present two and one-half-watt lamps. The results of this test were soon after (Fall of 1881) published in the London *Electrician*. So, if the incandescent lamp manufacturers can but perfect a filament which will stand the higher temperature required to accomplish similar results, it is plain that more will be done to further extend the use of incandescent lights than can possibly be accomplished by any further improvement in the machinery which produces current to operate them.

Regarding early storage battery work I would mention that N. de Kabath, of Paris, brought out in 1881 the de Kabath battery which was perfected by de Khotinsky, assisted by Hospitalier, which battery, while not long-lived, proved very efficient for a reasonable period. I fitted up with this battery an installation in the gas works of de Bruyn & Zonen in Amsterdam, Holland, in the Winter of 1881-82, using a gas engine to drive a Maxim dynamo, from which the battery was charged during the daytime, and during the evening the lights in the offices and other buildings of the gasworks and residences of the officers nearby were lighted. The results obtained were very satisfactory for about a year. Other noteworthy features of the installation were that the main consisted of an iron pipe conduit fitted with junction boxes which had removable covers, made waterproof by the use of rubber gaskets, in which conduit system gutta-percha insulated wires were used successfully. Further, portable lamps were provided in the offices, these lamps being connected with the fixed wiring system by means of a special flexible cable I had made in Paris (as at that time I knew of no flexible wires being regularly made), and at each end of said flexible cable, two-part wooden terminals were provided, which screwed together like the halves of a wooden push-button. Inside of these connections, between the fixed and flexible wires, we placed a fuse, consisting of a very small copper wire. This plant was installed by the gas company with a view to its going into the electric lighting central station business on a large scale if, when the rights (under which it operated the gas plant) expired, it should be unable to obtain a renewal of them.

Pardon my writing such a long letter, but the memories stirred up by the articles in your splendid issue are, I judge, a sufficient excuse for what I have written. With best wishes for the continued success of the ELECTRICAL REVIEW, I remain, as ever,

JOS. E. LOCKWOOD.

Detroit, Mich., January 31.

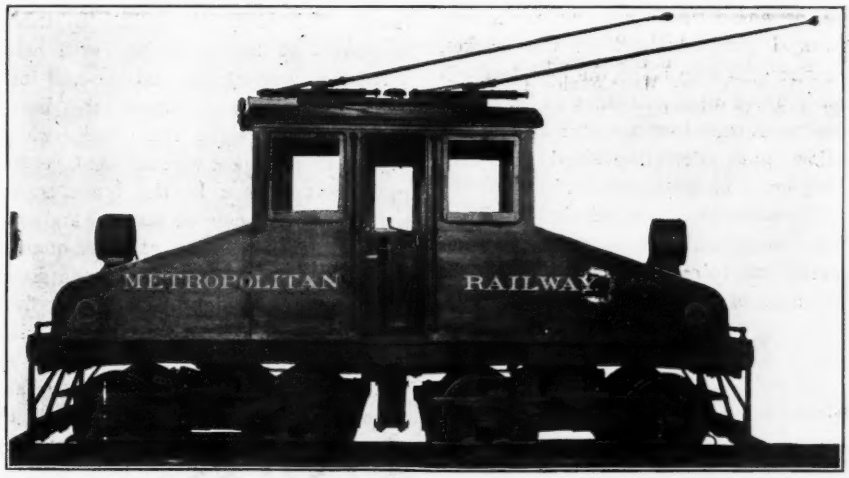


FIG. 8.—HEAVY ELECTRIC LOCOMOTIVE, BALDWIN-WESTINGHOUSE TYPE.

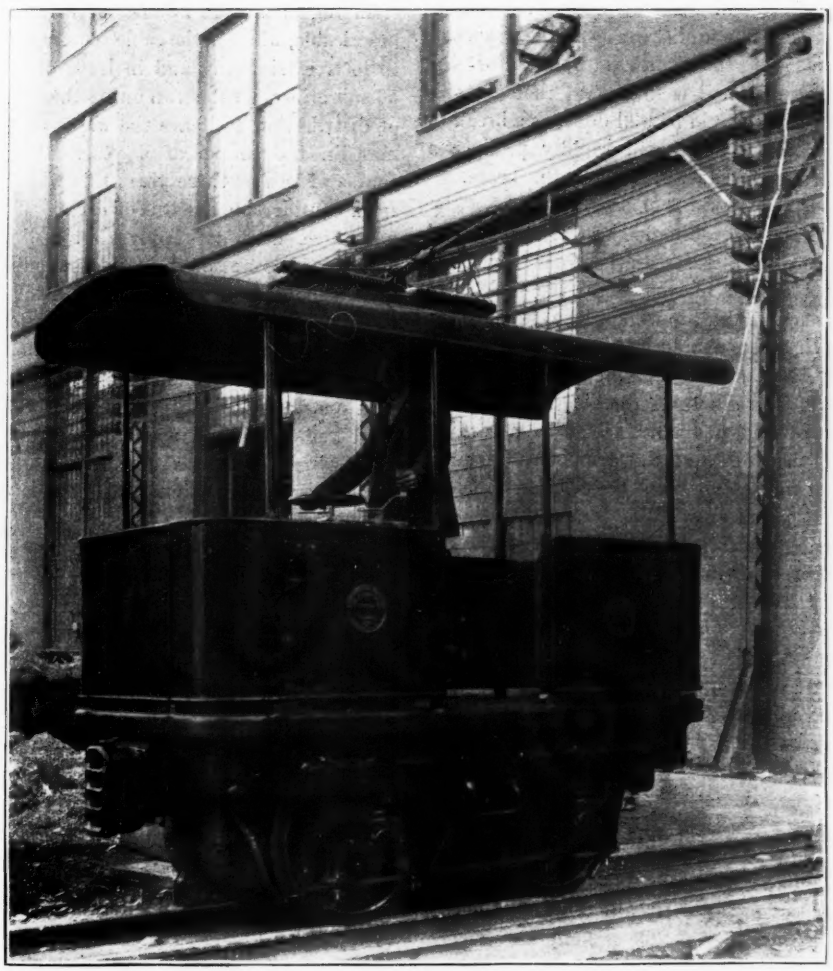


FIG. 7.—SMALL ELECTRIC SWITCHING LOCOMOTIVE, BALDWIN-WESTINGHOUSE TYPE.

THE CONSTRUCTION OF SMALL TELEPHONE EXCHANGES—III.

BY A. E. DOBBS.

CROSS-ARMS.

Pine, either white or yellow, is the only material generally sold on the market, the strongest arm being the long-leaf yellow pine of the southern states. Those who want the best specify: "Long-leaf yellow pine, straight-grained and free from knots or other defects."

There are two standard sizes of cross-arms in general use by telephone companies, one being the short and one the long arm, as follows:

STANDARD CROSS-ARMS.

No. Pins.	Length.	Spacings.			Approximate Weight.
		End.	Centre.	Sides.	
2	3 ft.	4	28	....	8 lbs.
4	4 "	4	16	12	12 "
4	5 "	4	18	17	15 "
4	6 "	4	24	20	18 "
6	6 "	4	16	12	18 "
6	8 "	4	18	17½	24 "
8	8 "	4	16	12	24 "
8	10 "	4	17½	15¾	30 "
10	10 "	4	16	12	30 "

Specifications—Cross-arms are made of yellow pine, finished to 3¼ x 4¼ and painted red, two coats, applied with a brush. Holes, unless otherwise ordered, bored for 1½-inch pins and 2¼-inch lag bolts.

SHORT TELEPHONE CROSS-ARMS.

No. Pins.	Length.	Spacings.			Approximate Weight.
		End.	Centre.	Sides.	
2	2 ft. 8 in.	3	26	..	7 lbs.
4	3 " 6 "	3	16	10	9 "
6	5 " 2 "	3	16	10	13 "
8	6 " 10 "	3	16	10	17 "
10	8 " 6 "	3	16	10	21 "
12	10 ft.	3	14	10	25 "

Specifications—Cross-arms are made of yellow pine, finished to 2¾ x 3¾ and painted red, two coats, applied with a brush. Holes, unless otherwise ordered, bored for 1¼-inch pins and 2½-inch lag bolts.

Some construction men prefer to use 12 instead of 10-pin arms, but the 10-pin arm is so easily counted in numbering wires that it still remains the favorite.

Pins of locust or chestnut are the most lasting we have at present. Oak pins and pine arms do not go well together, as the different acids of their juices in combination have a tendency to rot both woods.

Where light wire is used, as in towns, and the poles set not more than 80 feet apart, the short arm with its 10-inch spacing affords all the room needed for the wires, provided they are pulled tight, as they should be. Through the country districts, where poles are spaced farther apart and it is especially important that the wires should be always in working order, the long arm is more frequently used.

BRACES.

Of course cross-arms must have braces, and of these there is the small size 20-inch brace, which supply houses generally send out unless instructed to the contrary. This brace is one inch by three-sixteenths by twenty inches, with holes bored for three-eighths and one-half-inch bolts. While these braces are heavy enough for straight line work, where short arms and light wire are used, yet for permanent work a heavier brace is desirable, in which case we have one and one-quarter inches by one and one-quarter inches by twenty-two inches, with holes bored for three-eighths-inch and five-eighths-inch bolts. Some construction men use braces even longer than this, up to 24 or even 26 inches. If the braces are required to outlast two or more sets of arms they should be galvanized. If the braces are galvanized, the bolts used in connection with them should also be galvanized.

Never place galvanized and ungalvanized iron together, as the zinc coating and the iron will form an electrolytic couple which will not only eat away the zinc coat, but rust the iron as well. For the same reason it is important that the galvanizing should be well done, as a break in the zinc coating will rapidly produce a rust spot that will weaken the brace.

OTHER POLE FITTINGS.

Pole steps should be galvanized and measure nine-sixteenths inch by nine inches and driven into the pole five inches. Lag-screws for the twenty-two-inch braces should be nine-sixteenths inch by four and one-half inches, and carriage bolts for the same three-eighths inch by three and one-half inches, or according to the width of the arm. Washers are not necessary with these bolts. If the arm is put on with lag-screws they should be one-half inch by seven inches for the light arm, and one-half by eight inches for the heavy arm. They need not be galvanized. Use a washer on each lag-screw.

If the arm is put on with carriage bolts through the pole, a washer two inches by one-quarter inch should be used on the face of the arm and large round washers at the other side of the pole. Use a bolt five-eighths-inch diameter.

In planning the system to install, conditions will vary; but in these days of cheap cables, metallic circuits are advisable in all exchanges of 200 or more subscribers. At least the pole lines and circuits should be so arranged that the system can be easily changed to full metallic circuits.

In order to do this it will be necessary to install metallic-circuit switchboards, which adds but very little to the first cost and does away with a great deal of trouble and cross-talk.

The cross-connecting board and outside cables should also be kept in pairs, just as though the lines were to be metallic circuits, till the outside terminals are reached; then, if the line is to be a grounded or common return circuit, use one of each pair to connect to the ground or common return wire. With this arrangement, if any subscriber should want a complete metallic circuit—and some of them will—it becomes easy to disconnect the grounded leg and connect to the extra wire. This means the hanging of a great deal of cable, but this is not such a great hardship, for, as long as 100-pair cable can be purchased for 45 cents a foot or even less, it is nearly as cheap as the same number of No. 14 steel wires, while its freedom from trouble and the fact that it will last more than twice as long, make it more desirable in every way. More than this, in many towns shade-trees will make the stringing of a large number of wires impracticable, whereas the cable requires very little tree trimming and in leads of over 50 subscribers a cable run out to the centre of distribution will save the wages of one man in the course of a year. In the course of two or three years this will pay for a considerable amount of cable. This, of course, does not apply to toll lines, which, on account of their greater inductance, should be carried on pins as far as it is possible to do so, as one or two long toll lines will make the whole cable noisy.

The following estimate is based on a lead one mile in length, the cable of the kind known as light aerial, of 100 pairs (200 wires), No. 20 conductors, lead-covered and weighing about 2,870 pounds per 1,000 feet:

1 mile cable at 45 cents	$3,376
Span wire	170
2,500 cable clips	15
Messenger clips	10
Guying	25
Labor	75
Terminals	100
	$3 771

For the same number of steel No. 14 wires we have:

200 mile wire at $4.25	$850
8,000 insulators at $19 per 1,000	1,520
Pins	80
Cross-arms	176
Braces	140
Lags and screws	80
Guying	50
Labor and extras	200

There is also another difference not in the above estimate which, it will be observed, does not include the cost of the poles. One or two cables could be put up on 35-foot poles, while the steel wires would require at the least 55-foot poles, which, while it would be offset by from two to

five arms on the shorter poles for local distribution, would still make a difference of at least $300. There are also lighter cables used a great deal, especially in short lengths, made up of No. 22 conductor, weighing 2,260 pounds per 1,000 feet; which may be either single or double-wound.

A word as to single winding; there are some manufacturers who exploit an insulation which consists of a single paper wrapping instead of two, as in the former, the paper in the single wrapping being a little heavier than that on the double-wound conductor. The claims made for the single-wrapped are that the same thickness of insulation affords more air space between the conductors, and there is no better dielectric than dry air, and that the paper being more loosely wound will allow more bending of the cable without breaking than is the case with a conductor wound with two layers of tightly-wrapped paper. Most engineers, however, regard two layers as safer than one, even though they are more tightly wrapped, as the two layers are wound in opposite directions.

There is, however, another cable put out at a somewhat greater cost, that is used a great deal in underground work and which consists of two layers of rather heavy paper, loosely wrapped. This has attained a high reputation. The increased cost is due very largely to the larger diameter of the lead pipe into which it is drawn. As all manufacturers of paper cables can furnish the three kinds mentioned, purchasers can take their choice. The difference in cost between single and double-wound cable is from three to five per cent.

The following table gives the weights of the light, double-wound cable previously referred to:

FOR NO. 20 CONDUCTORS.

Pounds per 1,000 Feet.	Outside Diameter.	Thickness of Lead Sheath.
100 per 2,870	1.355	.115
75 " 2,250	1.285	.105
50 " 1,620	.986	.093
25 " 950	.731	.077

This cable is known as light aerial, and must not be mistaken for "Conference Standard" cable, which possesses nearly double the weights and thickness of lead given above.

FOR NO. 22 CONDUCTOR, DOUBLE-WOUND.

100 per	2,260	pounds	per	1,000	feet.
75 "	1,800	"	"	"	"
50 "	1,260	"	"	"	"
25 "	750	"	"	"	"

Underground cables will also generally run nearly double the weights given above.

Specifications for cables generally require that the conductors shall be of pure soft copper and the resistance to be as follows:

Size B. & S. Gauge.	Diameter Inches	Resistance per Mile.
18	.0400	35 ohms.
19	.0360	43 "
20	.0320	55 "
22	.0253	87 "

Resistance of the lighter cables shall not be less than 500 megohms, and for underground cables the requirements are sometimes placed as high as 1,000 megohms. It must not be supposed, however, that a 500-megohm cable will uniformly test at that amount, as, if the cable is carefully handled, it will average much higher.

What is known as "Conference Standard" cable represents the highest grade manufactured, and is made up according to specifications drawn by the various Bell companies some years ago for their underground work, as follows:

I. CONDUCTORS.

Each conductor shall have a diameter of .03589 inch (19 B. & S. G.) and have a conductivity of 98 per cent of that of pure copper.

II. CORE.

The conductor shall be insulated, twisted in pairs, the length of the twist not to exceed three inches and formed into a core arranged in reverse layers.

III. SHEATH.

The core shall be enclosed in a pipe composed of lead and tin; the amount of the tin shall not be less than 2.9 per cent. The pipe shall be formed around the core and shall be free from holes and other defects, and of uniform thickness and composition.

IV. ELECTROSTATIC CAPACITY.

The average electrostatic capacity shall not exceed .080 of a microfarad per mile, each wire being measured against all the rest and the sheath grounded; the electrostatic capacity of any wire so measured shall not exceed .085 of a microfarad per mile.

V. INSULATION RESISTANCE.

Each wire shall show an insulation of not less than 500 megohms per mile, at 60 degrees Fahrenheit when laid, spliced and connected to the terminal ready for use; each being measured against all the rest and the sheath grounded.

VI. CONDUCTOR RESISTANCE.

Each conductor shall have a resistance of not more than 47 B. A. ohms, at 60 degrees Fahrenheit, for each mile of cable, after the cable is laid and connected to terminals.

Clause 3, in regard to the amount of tin in the lead is sometimes waived in cable specifications as the tin has a tendency to harden the alloy and make it brittle; but, then, lead that is soft has a tendency to "creep," and, besides, pure lead has a tendency to corrode which the tin prevents. One manufacturer arrests corrosion by coating the outside of the lead with tin, which, it is claimed, attains this result even better.

Clause 4, in regard to electrostatic capacity is, of course, very low and unless specified the electrostatic capacity is apt to be somewhat higher, say from .1 to .19 or even 1.25 microfarads.

In buying cables, it pays to get the best.

We have so far spoken of paper cables not only because they are about the only kind used in large installations, but because they are the cheapest and best in almost every way, as they more nearly approach dry air as a dielectric. There are also cables with an insulation of rubber, in some instances with a lead sheath and in some without, but there is more induction in a rubber insulation than in paper, the difference being from three to five times greater. There is now, however, a large installation being planned which contemplates the use of lead-covered rubber insulation for underground work, the reason probably being to avoid the effects of punctures or leakage in the cables, which are specially aggravating in a central-battery system. It goes without saying that this experiment in a large system will be watched with a great deal of interest.

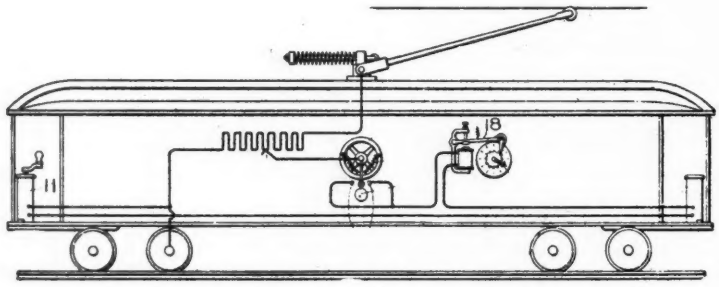
Electromobiles Do Not Freeze.

That electromobiles are superior to gasolene, steam or other self-propelled vehicles was easily demonstrated on the recent big run of the Long Island Automobile Club during the cold snap a few days ago. The weather was so cold that but five vehicles crossed the starting line, two of which were electric machines and three of a gasolene type. The two electromobiles "skated along, apparently heedless of the cold, but the gasolene wagons immediately began to take on cold storage features. Their frosty breaths fluttered weakly behind them and fell in hard chunks on the adamantine roadway. Then hoarse and throaty mutterings became audible—sounds that would stamp a horse as 'windbroken,' " and, as it was found impracticable to continue the run, the machines were stopped at the nearest roadhouse and an investigation was made, upon which it was found that the tanks of the gasolene machines were frozen. Having been thawed out, the party proceeded upon its journey, but it was necessary to stop every few miles in order to rethaw the freezing tanks. The members of the club were designated "Hardy Esquimaux," who, on their return, "combed the ice pendants from their whiskers and said they had had a great day of it."

Recent Electrical Patents

In order to prevent the too sudden or abrupt starting or stopping of cars and other electrically propelled machines, Mr. Albert G. Davis, of Schenectady, N. Y., has devised a scheme, the patent to which he has assigned to the General Electric Company. His idea is not only to prevent this, but also to record any attempt, tardation exceed a predetermined amount, the controller is automatically locked against further movement.

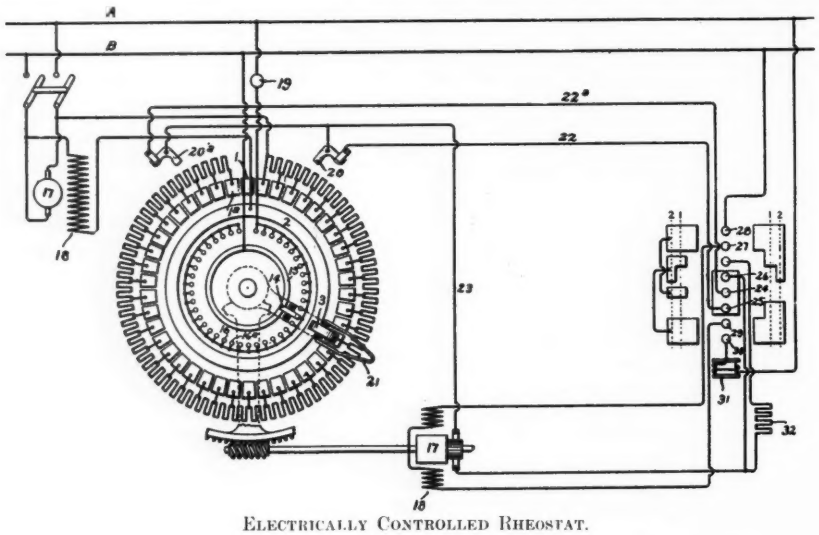
The General Electric Company has also obtained control of a patent taken out by Edward M. Hewlett on an improved power-controlled rheostat, the object of which is to permit the introduction or withdrawal from the circuit to be governed of a desired available amount of resistance, the resistance switch being governed by a source of power controlled by an operator. One particular use of



Acceleration, Limiting and Recording Device.

that the motorman or other operator will be automatically reported. In carrying out this idea he provides a pendulum, on opposite sides of which are arranged contact points in the circuit of a recording device. The electro-motive force in this circuit is obtained by connecting across suitable resistance, the trolley wire and ground return. In normal operation of the apparatus, the pendulum hangs between, but out of engagement with, the contacts. Should the car be started or stopped suddenly the inertia of the pendulum will cause it to be displaced from its middle position, and if the force be sufficient, it is swung far enough to make contact upon the one side or the other, thus closing the circuit and operating the recorder. At the same time, should this acceleration or re-

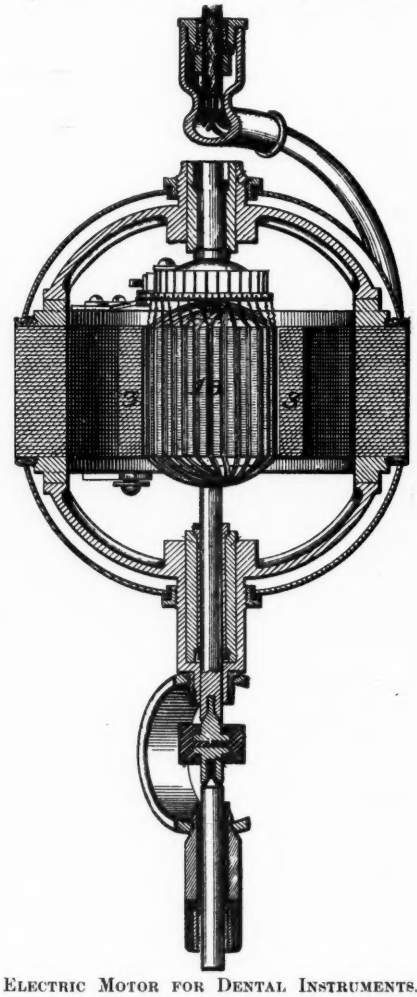
the invention is the regulation of resistance in the field circuit of a dynamo-electrical machine for varying the voltage of the machine, it being desirable to be able to manipulate a device of this character by means of a control switch at a distance from the rheostat. In carrying out the invention, he provides a range of contacts electrically connected with different resistance sections or spools of the rheostat, and provides in cooperative relation therewith a brush contact operated by an electrical motor connected with a speed-varying and current-reversing controller. An automatic switch is also provided for opening the motor circuit independently of the controller as the limit of travel over the range of contacts is approached at either end, these limit switches being so



Electrically Controlled Rheostat.

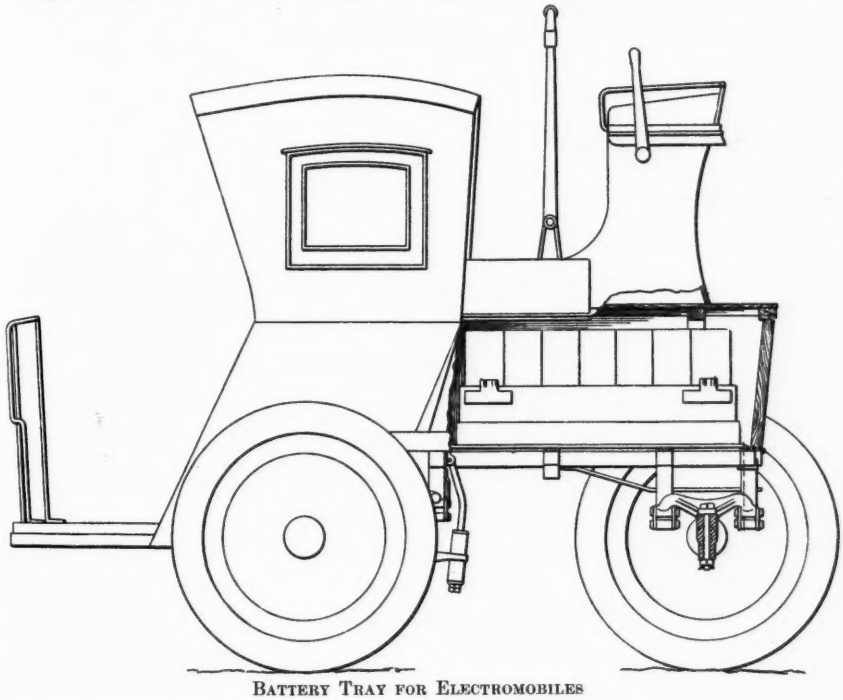
arranged that the motor circuit will always be in proper position to start the rheostat into action. In connection with the above, means are always provided for indicating to the operator whether the rheostat is in working order or not, a tell-tale device being provided for this purpose which indicates whether the rheostat contacts are in the proper engagement for a stable condition of the circuit, thus preventing the rheostat being left in a position where these contacts do not have a common current-carrying capacity, and avoiding damage to the apparatus.

An improved motor for dental instruments and the like has been a subject of a recent patent obtained by Oscar H. and Alphonse F. Piefer, Rochester, N. Y., the present construction being of the general type disclosed in former patents to the same inventors. The main frame or body consists of the annular or ring magnet composed of a number of separate flat plates of iron stamped from sheet metal and firmly secured together by bolts. These plates are all similar in form and have inwardly extending projections concaved at their ends and forming, when the plates are secured together, the pole-pieces



Electric Motor for Dental Instruments.

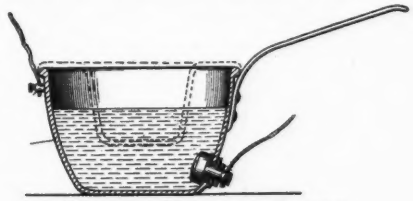
of the motor and adapted to receive the field coils which are capable of being slipped off said ends when the armature and suitable holding means are removed. The outer sides of the ring armature opposite the pole-pieces are recessed somewhat and brackets bridge these concavities or recesses. The ends of a hollow supporting yoke are mounted upon the brackets so that the motor is thus pivotally supported, the conducting wires passing through the arms of this bracket. On the opposite sides of the magnet ring are secured annular plates, and hemispherical cover plates are attached to the same and are provided with central openings through which the armature shaft passes.



BATTERY TRAY FOR ELECTROMOBILES

A new battery box or tray for motor vehicles has been invented by George H. Condict, of New York city, who has assigned the patent obtained thereon to the Columbia & Electric Vehicle Company. The vehicle, itself, which may be of any type and construction, contains an enclosed compartment called the "battery box." This is preferably at the rear portion of the vehicle, although it may be elsewhere, and is provided with a suitable door to permit loading and unloading the batteries. The desired number of cells are arranged on a tray, where they are suitably connected to form a unit sufficient for the purpose of operating the vehicle. In the interior of the battery box are located a number of contacts which are placed in the same relative position in different vehicles, in order to automatically engage and make contact with corresponding contacts on the tray. The trays with their load of batteries are heavy and not very readily displaced, yet it is exceedingly desirable to secure good electrical connections, and also to secure them so that they can be removed by the jolting of the vehicle. These advantages are secured by constructing the trays so that on their exterior they are wedge-shaped—that is, narrower at their front end and increasing in width toward the rear—and the stationary contacts of the battery box are so located that when the tray has been inserted endwise and pushed into its final position, the corresponding contacts carried thereby are wedged firmly against and between the contacts on the vehicle, automatically making a perfect electrical connection, and at the same time firmly holding the tray in position, so that it has no latitude of movement.

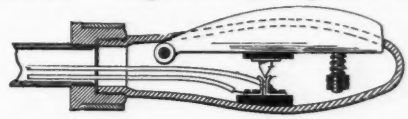
A novel idea in electric heaters for liquids has been patented by Joseph A. G. Trudeau, of Ottawa, Canada. It consists substantially of a metallic receptacle, having an electrode passing through but insulated from the wall thereof and near the bottom. One of the conducting wires is secured to this pole, while the other is grounded upon the metallic wall. Owing to the very high resistance of water, and diffusion therein of carbonate or other



ELECTRIC HEATER FOR LIQUIDS.

certain other liquids, it is not practical to use them in the receptacle in their natural or normal state, and therefore the inventor decreases the resistance by the salt of sodium or like suitable substances. When the current is turned on to the receptacle containing the liquid, the latter is soon heated to a very high temperature, and other vessels may be suspended therein containing articles desired to be heated.

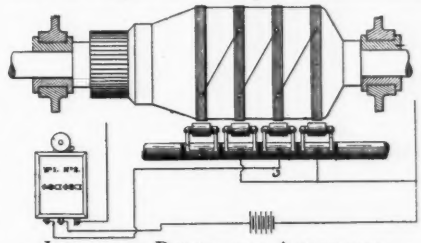
A novel switch for electric sparking apparatus of explosive engines used on automobiles is designed to form a part of the



ELECTRIC CONNECTING HANDLE FOR AUTOMOBILES.

steering handle. The hand grip is hollow and the wires lead thereto and are fastened to a pair of spring clips separated a suitable distance apart. Pivoted in the grip is a small lever which has a portion projecting from the exterior face of the same, a suitable coiled spring being provided to hold it in its projected position. The under side of this lever is provided with a wedge-shaped metallic block which is adapted to be forced between the two spring arms and thus close the circuit when the lever is forced inwardly. It will thus be evident that as long as the handlebar is grasped the lever will be forced inwardly and the circuit completed, and as soon as the person alights from the vehicle, whether voluntarily or involuntarily, the circuit will be broken and consequently the machine stopped. The inventor of this idea is a North Carolinian, Edward N. Dickerson by name, who resides at Stovall.

In order to prevent the destruction or injury of electric motors or generators, Mr. Joseph F. Watson, of Philadelphia, Pa., has devised an ingenious device which will indicate any disarrangement of the armature should the journals wear out of true and permit it to come into dangerous proximity to the pole-pieces. In carrying out this idea, he secures upon the armature



INDICATING DEVICE FOR ARMATURES.

a plurality of separated annular metallic bands having electrical connection with each other. Beneath the armature, and longitudinally thereof, is located a shaft made up of sections insulated from each other. Each section carries a roller which is arranged in juxtaposition to one of the rings upon the armature, and suitable electrical connections are made between these sections and a telltale device. By this construction, should the armature drop down or the journal wear so as to permit its uneven movement, certain of the rings carried thereby will come into contact with the rollers of the shaft beneath, thus closing the circuit and indicating the same to the attendant.

THE ECONOMIC RADIUS OF ARC-LAMP SERVICE FROM CONSTANT-PRESSURE DYNAMOS.

BY ALTON D. ADAMS.

The most serious general objection to the distribution of arc lamps directly from constant-pressure dynamos at central stations, is the fact that the lamps are not individually independent of each other, where two or more are in series. In any series arrangement of the arcs, one or more of the series may be discontinued, while the others of that series remain in operation, only by the introduction of a resistance into that series equal to the resistance of its turned-out lamps. Notwithstanding this difficulty, great extensions in the service of arc lamps directly from constant-pressure supply mains is constantly going on under two distinct conditions. First of these is the supply of arc lamps in multiple from the same mains that deliver energy to incandescent lamps. Illustrations of such service are found in connection with nearly all central stations for indoor lighting, and in some instances for street lighting, as on Fifth avenue, New York, where the arc street lamps take current from the Edison mains. The other class of cases, where arc lamps are supplied directly from constant-pressure dynamos, occurs where series of two or more arcs are operated at constant pressure, because all of the lamps in each series are wanted when any is necessary, as in some large buildings, industrial works, and for street lighting. Arc lamps operated by electric railway systems are in almost every case connected first in short series, varying in the number of lamps each, according to whether open or enclosed arcs are used, and then enough of these series in multiple with each other to give the required capacity. In that department of arc service where the greatest possibility exists for series operation from constant-pressure dynamos direct, namely, in street lighting, comparatively little has been done, especially in the United States. Throughout the country hundreds of thousands of arc street lamps nightly burn, the lamps on each circuit being all required for the same period, in most cases. In the great majority of instances arc lamps for street lighting are operated by the same class of dynamos, and often even by exactly the same machines that were in use for the purpose 10 and 15 years ago. These "series," or constant-current arc dynamos, are necessarily of small capacity, a single machine being usually under 100 lamps, or about 80 electrical horse-power output, because about 50 volts must be allowed for each open arc lamp and something for line loss, so that the pressure of a constant-current dynamo, operating 100 open arcs on a series circuit, reaches nearly 6,000 volts. Such a high pressure has been found to be impracticable for overhead arc lines in most parts of the country, because of the serious leakage of current from them in wet weather and the general difficulty of insulation. Arc dynamos of 50-lamp capacity are, consequently, in much more general use than are those for 100 arcs, though 150-lamp machines are sometimes used. In many central stations, doing a large amount of street lighting, dozens of these small arc dynamos for the supply of street circuits may be found usually driven by belts. Efficiency in these constant-current dynamos is quite low, often only 75 to 80 per cent, partly because of their small individual capacities, but more especially by reason of the necessarily inherent construction for the production of constant current.

In order to avoid the disadvantages incident to the operation of many small, constant-current dynamos at central stations constant-current transformers and rectifiers have been introduced to supply series lines of arc lamps from alternating generators. With the constant-current transformers alone, series of alternating arcs are operated, but if direct-current arcs are wanted the rectifiers must be used with the transformers. These constant-current transformers have the property of regulating the current in the lamp circuit so that it remains nearly constant, whatever the variation in the number of lamps on the circuit in operation, as do arc dynamos. Constant-current transformers and rectifiers for each arc-lamp circuit, in addition to the necessary dynamo capacity, cause a material increase in the expense of central station equipment, and there are some problems in connection with these devices yet to be solved. It is not clear as yet that constant-current transformers in connection with rectifiers will generally displace the old arc dynamos that are still doing the great share of street lighting. Meantime the operation of arcs directly from constant-pressure circuits, both direct and alternating, is making progress as above noted. The greatest impediment to the more rapid extension of arc service from constant-pressure lines, in the case of lamps in multiple, and also where series of arcs are required, each lamp of a series burning as long as any of the others, as in street lighting, is the cost of the arc-lamp lines. Where arc lamps are operated from the constant-pressure mains that supply the incandescent service, the voltage at which the branches to arcs are served is usually 110 or 220, to correspond with the voltage of incandescent lamps, or that of a three-wire system which operates them. In the comparatively few instances where 220-volt incandescent lamps are supplied from a three-wire system with a maximum of 440 volts; this pressure is available for arc-lamp branches. Either of these pressures is a small fraction of the 2,000 to 3,000 volts at which series arc lines are generally operated, and as the weight of copper necessary to transmit a given amount of electrical energy over a fixed distance, at a certain per cent of loss varies as the square of the voltage at which the transmission takes place, it seems at once obvious that the economic radius of distribution for arc lamps at these low voltages must be much less than that with ordinary arc dynamos. In cases where large numbers of arc lamps for street lighting all require to be operated during the same period so that regulation on the several series circuits is not necessary, these lamps may be supplied from constant-pressure mains with advantage, if the cost of the branches to arcs is not excessive. If it can be shown that the cost of branches to arc street lamps, for the case just noted, is no greater than the cost of lines from regular arc dynamos, a single set of large generators at the station may supply all of the light required, both arc and incandescent. Before entering on a comparison of the relative costs of arc lines from constant-current and from constant-pressure dynamos, it is well to point out that the volts required at each lamp are rapidly changing from 50 to 80. The reason for this change is the superiority of the enclosed arc, in which the volts between the carbon points are increased to about 80, because of the nature of the gases in which it is confined. This rise of lamp voltage obviously reduces the number that may be operated on a regular arc dynamo of given pressure. Thus, while a dynamo of 6,000 volts and constant current will operate 112 open arc lamps at 50 volts each on a line where there is a drop of 300 volts, or five per cent, the same pressure suffices for only $5,700 \div 80 = 71$ enclosed arcs. While distribution from constant-current dynamos is subject to a considerable loss at the station, distribution at constant pressure involves a similar loss between the mains and the arcs. This loss is in large part a necessary one, from the fact that every arc lamp supplied from constant-pressure mains must have between it and the main a considerable resistance to obtain steady

and satisfactory working. Much the greater part of indoor lighting with arc lamps is now done by the enclosed variety, and they may be expected to displace open arcs for street service as time goes on, as they have already done in some important instances. Examples of this change are seen in a part of the arc street lamps at New York city and in nearly 3,000 at Boston. Where arc lamps, that each require 80 volts only, are supplied from either 110 or 220-volt mains it is evident that a considerable excess of pressure must be consumed by some means aside from the arcs, in each case. Thus, where an 80-volt lamp is supplied from 110-volt mains, $110 - 80 = 30$ volts must be used in resistance in series with the arc. Where two enclosed arcs are fed in series from 220-volt mains, 60 volts must be substracted from the line pressure before it reaches the lamps. The differences of pressure between those at the mains and those at the lamp or lamps must become a drop between the terminals of a resistance when the normal lamp current is passing. For the cases just cited, the losses of pressure between the mains and the lamps are usually secured through special resistance coils connected in the lamp circuits, at or near the point where the lamps are in use. The fall of 30 volts, between the mains at 110 volts and the lamp terminals, involves a loss of $30 \div 110 = 27$ per cent of the total energy drawn from the line, as does also the drop of 60 volts between 220-volt mains and the terminals of two lamps in series. At present this large waste of energy serves no useful purpose save to reduce the line pressure to the required amount at lamps, and to ensure steady operation. The arc-lamp branches usually are proportioned for only a small loss, say two or five per cent, as for incandescent service. Under these conditions the cost of arc-lamp branches reaches an excessive figure at comparatively moderate distances from the mains, as an example will show. Let it be required to operate an enclosed arc, requiring six amperes and 80 volts, at a distance of 1,000 feet from constant pressure, 114-volt mains, with a drop of four volts in the arc-lamp branch. For this purpose a No. 5 copper wire, of 0.182-inch diameter, is necessary, and the weight of the required length of this wire is 200 pounds without insulation. At 20 cents per pound, this weight of copper costs $40, and the cost of insulation, which will vary according to its quality, may be as much more. As the weight of copper for this lamp branch will vary as the square of the distance of the lamp from the main, for a constant loss in it, the cost of the copper alone, where the lamp is 2,000 feet distant, rises to $160, which may again be doubled to cover insulation.

If, instead of allowing a drop of only four volts in the arc-lamp branch, and then 30 volts in a special lamp resistance, the entire drop of pressure between the mains and lamps had been concentrated in the branch wires, a very different result as to their cost would have been obtained. A No. 18 copper wire of 0.040-inch diameter will deliver six amperes to a lamp 1,000 feet distant from the mains, where the drop of pressure in the branch is 34 volts, and the weight of bare wire necessary is only 10 pounds. No. 18 wire is too small, however, to carry the six amperes without an undesirable rise of temperature and, if the wire is exposed, its mechanical strength is far too small. It is, therefore, impossible to secure the full drop of pressure named in an arc-lamp branch of the given length, and a larger wire must be selected, not for the drop of pressure in it but of ample carrying capacity and mechanical strength. A No. 12 copper wire is well suited for the purpose where the branch is not exposed to very severe mechanical strains, as on long spans from pole to pole, and the weight of copper in No. 12 wire for this branch is 40 pounds, against 200 pounds of No. 5 wire, when most of the drop in pressure took place in a special resistance at the lamp. But in street lighting it is often necessary to locate arc lamps at distances much greater than 1,000 feet from constant-pressure mains, and here the full advantage of the large drop of pressure in arc branches, instead of that in special resistances, becomes evident. To provide against the strains incident to long spans a No. 10 wire may be selected for branches to quite distant street lamps, especially where these branches are erected overhead.

Using No. 10 copper wire, an arc lamp requiring six amperes and 80 volts may be operated at a distance of 2,779 feet from 114-volt mains, when the entire drop of 34 volts takes place in the wire. This result is readily deduced, taking the resistance of No. 10 wire at 1.02 ohms per 1,000 feet, from $6 = 34 \div$ ohms, therefore ohms $= 5.66$, and $1{,}000\ (5.66 \div 1.02) = 5{,}549$ feet, because the total length of the circuit is double the single distance, which is $5{,}549 \div 2 = 2{,}779$ feet. The bare wire weighs 31.4 pounds per 1,000 feet, so that the weight of copper to supply an enclosed arc lamp, consuming $80 \times 6 = 480$ watts, at a little more than one-half mile from 114-volt mains, is only 174 pounds. The actual weight of wire is somewhat more than this, owing to the necessity for insulation. For the case of a three-wire system at 228 volts, a series of two enclosed arc lamps, requiring six amperes and 80 volts each, may be operated at the distance of two (2,779) feet from the constant-pressure mains, because the volts at the two lamps must be $80 \times 2 = 160$, so that $228 - 160 = 68$ remain as the drop in the branch wires, or just twice the drop for the previous case. Double the loss of pressure for equal amperes in the same size of wire obviously implies double the former resistance and length. Two enclosed arcs may thus be operated at a distance of 5,558 feet, or more than one mile, from constant-pressure mains, as commonly employed for the three-wire system. The weight of copper for each of the two arcs, at about one mile from the three-wire mains, remains the same as that for the single arc at one-half mile from 114-volt mains. The differences of pressure between that at the mains and that at the lamp or lamps for the cases just considered is somewhat more than is necessary for steady operation at the lamps, but the voltage of incandescent lamps fixes the pressures at the mains, some small allowance being made for loss in branches, and the excess of the main voltage may well be put to some useful purpose. It should be held in mind that the loss of energy between constant-pressure mains and arc lamps has been found to be fully warranted, because of the great economies involved in the use of a single type of generators and set of mains for both arc and incandescent lamps. Where arc lamps in series are operated from constant-current dynamos, the losses at stations, incident to many small engines, or to shafting and belting, and to the low efficiency of the arc machines, are so large that a high efficiency for the line conductors is very desirable. If the series arc line from a constant-current dynamo has in it a drop of one-tenth of the total voltage, the efficiency will be below that generally advisable. For the cases of one arc lamp at 2,779 feet from a 114-volt main, or two arcs at 5,558 feet from a 228-volt main, the extension of a branch from the main to the lamps is much cheaper than the extension of the circuit from an arc dynamo to the same lamps, if the extension of arc dynamo circuit must be equal in length to the branches from the constant-pressure mains. If the lamps each require six amperes and 80 volts, the pressure available in the arc dynamo circuit per lamp is $80 \div .90 =$

88.88 volts, if the line has an efficiency of 90 per cent.

The pressure that may be lost in the wire of the constant-current circuit is thus 8.88 volts per lamp. In the case where the circuit from an arc dynamo is to be extended to a lamp distant 5,558 feet from the nearest point on the line, the size of wire necessary to hold the drop in volts at that for one lamp is circular mils = $(5,558 \times 10.5 \times 6) \div 8.88 = 39,431$, which very nearly corresponds to a No. 4 wire. One thousand feet of No. 4 wire, bare copper, weigh 126.3 pounds, so that the 5,558 feet in the present case have a weight of 702 pounds, or four times the weight of No. 10 necessary to supply a lamp at the same distance from constant-pressure mains at 114 volts. If two lamps are to be operated at a distance of 5,558 feet from the starting point on a circuit from a constant-current dynamo, the volts available for the drop in the wire of the extension are $8.88 \times 2 = 17.76$, or twice the amount in the previous example, so that as the distance is also doubled, the size of wire required remains the same, though its weight is twice as much as before. These examples show that where one or two arc lamps are desired at points distant as stated from constant-pressure mains at 114 or 228 volts, and from a constant-current arc circuit, four times as much copper must be used to supply the lamps from the constant current as from the constant-pressure circuit, all the factors being as stated. It may be fairly said, however, that more than one or two arc lamps may often be supplied by an extension of a constant-current circuit to distances of one-half mile or one mile from given points on it. Unless more than eight arcs can be connected over the distance of one mile, or more than four arcs cover the distance of one-half mile, from any point where the constant-current and constant-pressure circuits coincide, the constant-current circuit offers no saving of copper for the line efficiency stated. The mains and feeders of three-wire systems at 220 to 250 volts are now commonly extended to distances of as much as one mile from the central station. As above pointed out, branches from these three-wire mains may be economically extended in any direction to a distance of one mile for arc lamps, so that, if the station is in the centre of the district served, arc lamps may be supplied over an area four miles square where 220 or 250-volt incandescent lamps are distributed on the two-wire system, the advantages for arc-lamp distribution remain the same as for the three-wire system using 110-volt lamps. On three-wire systems using 250-volt incandescent lamps and thus having a maximum pressure of about 500 volts, and also on street railway systems of 500 to 600 volts, the economical area of arc service is further extended. At about 110 or 220 volts it is necessary to consume the excess of pressure above 80 or 160 volts in resistance, independent of the amount of resistance required for regulation, because the former of these voltages is not enough for two and the latter not enough for three enclosed arcs. Where 500 or 600 volts are available at the constant-pressure mains, the number of arc lamps that are operated in each series between the mains may be raised to the point where further increase would render their action unsteady. The per cent of total pressure that may be consumed in arc lamps on constant-pressure mains, with steady operation, is not uniform, but varies to some extent with the lamp construction. If one-fifth of the total pressure between mains is expended in resistance apart from the electric arcs, steady operation will be assured for almost any good lamp. Applying this rule to a 500-volt circuit of constant pressure, 100 volts should be consumed in resistance and 400 used in the arc lamps. As each lamp requires 80 volts, five enclosed arcs should be connected in series with enough resistance to cause a drop of 100 volts with the six amperes of current. Using No. 10 wire as before, with a resistance of 1.02 ohms per 1,000 feet, and noting that the resistance of the line should be 16.66 ohms, it appears that the length of wire used for each series of arc lamps may be 16,333 feet. The distance to which the series of five arcs may extend from the 500-volt mains is thus 8,266 feet or one and one-half miles with No. 10 wire. If a larger wire is used the distance at which arcs may be served from, either any point on the mains or from the station, is increased in proportion to the area of the conductor. Thus if No. 7 wire is employed, the series of five arcs may extend three miles from the main or station, as this wire has twice the section of a No. 10. As 500-volt feeders and mains often extend three or four miles from the generating station, the radius of economical distribution for arc lamps from the station is little, if any, under five miles. Still, another expedient remains for the operation of arc lamps for street lighting from stations having 500-volt generators. Two of these 500-volt generators may be connected in series during the times that street lamps are wanted, and series of arcs connected to the 1,000-volt supply thus created. Each series of lamps will contain 10 80-volt arcs, leaving 200 volts for the loss in the line resistance. With No. 10 wire the total length of line may be 32,666 feet for each series of 10 lamps, from the station or from any point on the 1,000-volt mains. This corresponds to a radius of operation of three miles from any point on the mains with No. 10 wire. If No. 7 wire is used the radius of operation is doubled to six miles. The 1,000-volt mains may well extend several miles from the station, so that the radius of operation may be extended to eight or 10 miles with less copper than an efficient system from a regular arc dynamo.

Views, News and Interviews

The Turin Academy of Sciences will award, at the end of the year, its Bressa prize, of the value of nearly $2,000, for the most important investigation or invention made in a scientific subject during the past four years.

A measure was recently introduced into the legislature of the state of Illinois, at Springfield, to institute the electric chair as a means of capital punishment. At the present time the death penalty is inflicted in that state by hanging.

The Rœntgen Society, London, offers as a gift from its president, Dr. J. Macintyre, a gold medal to be awarded to the maker of the best X-ray tubes. They must be forwarded to 20 Hanover square, London, so that they arrive not later than May 1, 1901.

In stringing the long-distance telephone line of the American Telephone and Telegraph Company between New York and Boston, aerial lines were used to span rivers in order to avoid the inductive effect of submarine cables. In crossing the Connecticut River, near Middletown, Ct., the span is 1,300 feet long. Structural steel towers were erected on either bank, the 40 wires of the system being stretched between them. The wires are placed in groups of 10 on each arm, about 12 inches apart, and insulated by saddle-shaped insulators, being strung at equal tension to avoid accidental crossing in windy weather.

It is strange how the old "chestnuts" seem to go through some process of revivification, like the Phœnix. Here is one that the esteemed Cincinnati *Enquirer* has resuscitated from its sleep of years:

"Anderson, Ind., January 16.—A number of people here have found that the little pieces of carbon that are found on the street where the electric light trimmers drop them are apparently a splendid remedy for rheumatism. The broken pieces are carried in the pockets or are placed near the seat of the pain. The wife of a well-known business man had rheumatism in her feet until she could hardly walk. She put pieces of this carbon in her stocking and is now completely well. There are a number of cases here where it is said the carbon has effected noteworthy cures."

PERSONAL.

Mr. A. L. Bagnall, a member of the well-known electrical engineering firm of Bagnall & Hilles, of Yokohama, Singapore and Manila, is visiting the United States to purchase supplies for a proposed electric railway in Tokio, Japan. While in New York city Mr. Bagnall made his headquarters at the offices of the New York Insulated Wire Company, 15 Cortlandt street.

Mr. A. Wilford Zahm has resigned as secretary and general manager of the Manhattan Light, Heat and Power Company, of St. Paul, Minn., to become general manager of the Light, Heat, Transit and Public Service Company, of St. Cloud, Minn. The latter company is a recent consolidation of heating, power and electric railway interests.

Mr. E. F. Seixas has resigned the position of general manager of the Amsterdam, N. Y., Street Railroad to become general manager of the Niagara, St. Catherines & Toronto Railway, and the Niagara Falls, Wesley Park & Clifton Tramway Company, succeeding Mr. F. A. Cheney.

Mr. Stewart S. Neff, a well-known railroad man, has been appointed superintendent of the elevated roads of the Boston, Mass., Elevated Railway Company. Mr. Neff will establish a kindergarten for the education of trainmen in signals, automatic air brakes and the multiple-unit system of electrical control.

Honorable Allan L. McDermott, of Jersey City, N. J., has been elected president of the Washington Traction and Electric Company, of Washington, D. C., succeeding Mr. Frederick C. Stevens, who will hereafter devote his attention to the West End National Bank, of which he is president.

Mr. S. G. McMeen, chief engineer for the Central Union Telephone Company, Chicago, Ill., will lecture before the engineering students of Purdue University, La Fayette, Ind., on February 27, his subject being "Modern Developments in Telephony."

Mr. C. C. Warren, president of the Warren Electric Manufacturing Company, Sandusky, Ohio, accompanied by Mrs. Warren, sailed from New York on the Quebec Line steamship Trinidad for Bermuda, on February 16.

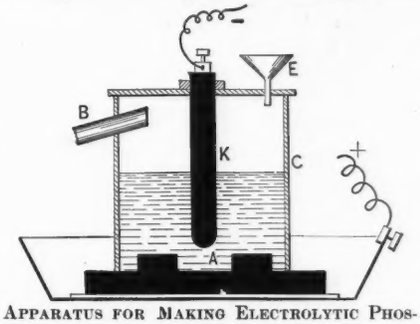
Mr. W. F. Greenwood, chief engineer and general manager of the Havana Electric Company, of Havana, Cuba, is visiting New York city on business.

Mr. W. J. Clark, of London, manager of the General Electric Company's foreign department, is visiting New York city.

Mr. Harold Fraser has been appointed superintendent of the gas and electric light plant at Brockville, Ontario.

Electrolytic Phosphorus.

There has recently been patented in Germany a process for the electrolytic preparation of phosphorus from phosphoric acid and charcoal. The illustration herewith gives an idea of the arrangement of the apparatus. Free phosphoric acid is concentrated by boiling to a density of from 60 to 70 degrees Beaumé and is mixed, while still hot, with coarse charcoal or coke in the proportion of from four to five parts by weight of the acid to one of the carbon. This mixture is charged through the funnel E into the apparatus



APPARATUS FOR MAKING ELECTROLYTIC PHOSPHORUS.

as shown. The bottom of the cylindrical chamber is formed by a heavy cake of carbon A, and through the lid projects downward the carbon rod K, which forms the negative electrode. The apparatus sets in a pan as shown, through which is connected the positive terminal of the feeding circuit. Current is applied at a pressure of 120 volts, from 80 to 150 amperes being ordinarily absorbed in the process. As soon as the greater part of the phosphoric acid is decomposed the current is interrupted for a moment and fresh portion of mixture is introduced. As very little residium is formed the process goes on for considerable time without necessity for cleaning or dismantling the apparatus. The phosphorous vapors produced are let off through the pipe B to appropriate condensing chambers. This process is known as the Dile system.

Dr. F. J. Machalske, of Long Island City, N. Y., has lately been experimenting on a large scale for the production of phosphorus directly from phosphate rock without the latter undergoing any preliminary chemical treatment. The details of this method are not at present available for publication but the method is one in which the electric furnace is used.

In the course of the experiments, while using Tennessee phosphate rock and working under a current of 4,000 amperes at 20 volts, there was eliminated from the rock in small quantities a metal of a silvery appearance, having a specific gravity of 10.02 and possessing some curious properties. It apparently is unaffected by sulphuric acid or hydrochloric acid, and is very slightly affected by nitric acid. At the common temperatures the metallic substance seems to be a good conductor of electricity, but its resistance increases enormously with temperature, so that at 100 degrees centigrade it is practically a non-conductor. In other experiments made by the same investigator he has succeeded in producing the valuable substance known as carbon tetrachloride by treating a mixture of rock-salt, carbon and sand in the electric furnace. This substance, together with the other chlorides of carbon, goes off as a vapor and is condensed. Its use in the arts has been somewhat limited owing to its scarcity, but it is likely to find a considerable usefulness as a solvent. Possessing the same qualities as the light naphthas and gasolene as regards its power to dissolve grease and oil, it is at the same time non-inflammable and non-explosive and it is thought that the future will find its use widely increased.

The uses of phosphorus in the arts are confined at present to the manufacture of matches, fireworks and for a few other purposes, but the compounds of phosphorus are of the highest value, especially in agriculture, where they are the base of the majority of chemical fertilizers.

New York Electrical Society.

The 212th meeting of the New York Electrical Society was held in the rooms of the College of the City of New York, at 8 P. M., on February 14. Twelve names were proposed for membership and duly passed, and the lecture of the evening was given by Mr. Kempster B. Miller, chief engineer of the Kellogg Switchboard and Supply Company, of Chicago, Ill., his subject being "Modern Telephone Engineering." The lecturer read a most excellent paper, illustrating his remarks with a number of fine lantern slides. He treated the subject both from the standpoint of the subscriber and from that of the engineer, punctuating his remarks with an occasional witticism. At the close of the lecture the president of the society thanked Mr. Miller in the name of the organization, and announced that the next meeting would be held in the stables of the Electric Vehicle Company, Forty-ninth street and Eighth avenue, New York city.

Electric Railways

An electric street railway will soon be built between Taunton and Berkeley, Mass., by the Taunton & Berkeley Street Railway Company, a newly chartered corporation.

An extension will soon be made to the Pottsville, Pa., Union Traction Company's lines of nine miles. This company controls all the trolley lines in Schuylkill County and has 46 miles of road.

Reports are current in upper New York state regarding a new trolley line which will be constructed by Joseph A. Powers and A. B. Colvin from Fort Edward to Granville and West Pawlett *via* Hartford.

The Little Consolidated, of Cleveland, Ohio, is seeking to lay the tracks of its proposed Lake Avenue extension across the Boulevard and Edgewater Park, and it is believed that the enterprise will be successful.

Reports from North Yakima, Wash., state that the system of electric roads to be operated as feeders to the Northern Pacific Railroad is one of the electrical enterprises now under consideration in the far Northwest.

At a recent special meeting of the Doylestown & Danboro, Pa., Turnpike Company it was decided unanimously to lease the road to the Doylestown & Easton Electric Street Railway Company, which will build a trolley line between the two cities named.

Financial arrangements for the Indianapolis, Morristown & Rushville, Ind., Traction Company are said to have been completed, and the contract for the construction of the road from Indianapolis to Rushville and from Morristown to Shelbyville awarded.

At a recent meeting of the stockholders of the Worcester, Mass., & Blackstone Valley Street Railway Company, it was decided to build a large power-house on the banks of the Blackstone River, and it is believed that the site will be either in Millbury or Wilkinsonville.

A franchise has been granted by the Baltimore, Md., county commissioners to local capitalists for the construction of an electric railroad on the Philadelphia road from the eastern boundary of Baltimore to the Harford County line, near Joppa, on the Baltimore & Ohio Railroad.

Early in the evening of January 26 the large power-house of the Metropolitan Street Railway Company, at Ninth and Washington streets, Kansas City, Mo., was destroyed by fire, entailing a loss of $150,000. Besides the destruction of the building 56 cars were entirely burned.

The county commissioners of Rushville, Ind., have refused to grant rights of way over the Arlington Pike to the Indianapolis, Morristown & Rushville Traction Company, believing that if they did so it will establish a precedent which they think would be detrimental to the welfare of the village.

The Golden Reward Mining and Milling Company, of Spokane, Wash., has decided to build a trolley line a mile long from the tunnels of its mine to connect with the railroad to the Curlew Smelter, thus placing the mine in direct communication with the mills, making the treating of ores an inexpensive operation.

A large power-house is soon to be built in Jackson, Mich., by the Boland electric railway interests. Present estimates call for between $200,000 and $250,000 for the plant, which will furnish power for running the cars between Ann Arbor and Kalamazoo, with probably further extensions in the near future.

It is probable that the proposed electric railway between Greenfield and South Deerfield, Mass., will be built in the early Summer. At a recent meeting of the company it was determined to capitalize the road for $60,000 and power will be obtained from the Conway Electric Light and Power Company, at South River.

Reports from Chatham, Ont., state that Ypsilanti, Mich., capitalists are agitating an electric road from Windsor to Chatham. The Americans are represented by Mr. Joseph Webb, and the railway committees of the councils of Chatham and Kent counties recently passed resolutions promising to give the road all the support in their power.

Reports from Asbury Park, N. J., state that plans are on foot for the construction of an intricate system of electric railroads throughout the northern part of Monmouth County. Ten towns will be connected with intermediate villages and Red Bank will be the centre of the system. From there the lines will run to Atlantic Highlands, being completed during the coming August, unless some now unforeseen delay is experienced.

The breakdown which occurred on the Central London (England) Railway, near Notting Hill Gate Station, recently, caused considerable inconvenience and when the train was examined it was found that the brake gear of one of the coaches had become detached, touching the central rail through which the current flows, thus causing a short-circuit and melting the contact-breaker at the section substation, which cut off the current from the east-bound track and blocked all the trains. The delay was of an hour and three-quarters duration.

The bill which was introduced recently into the Assembly of the state of New York by Mr. J. T. Smith, of Dutchess County, is believed to be in the interests of the electric railroad between New York and Boston, which will be built by the Whitney-Widener-Elkins syndicate to parallel the New York, New Haven & Hartford steam railroad. The bill in question gives a surface railroad the right to acquire by condemnation proceedings rights of way outside of the corporate limits of cities or villages along its route. Similar measures have been proposed in the Connecticut and Rhode Island legislatures.

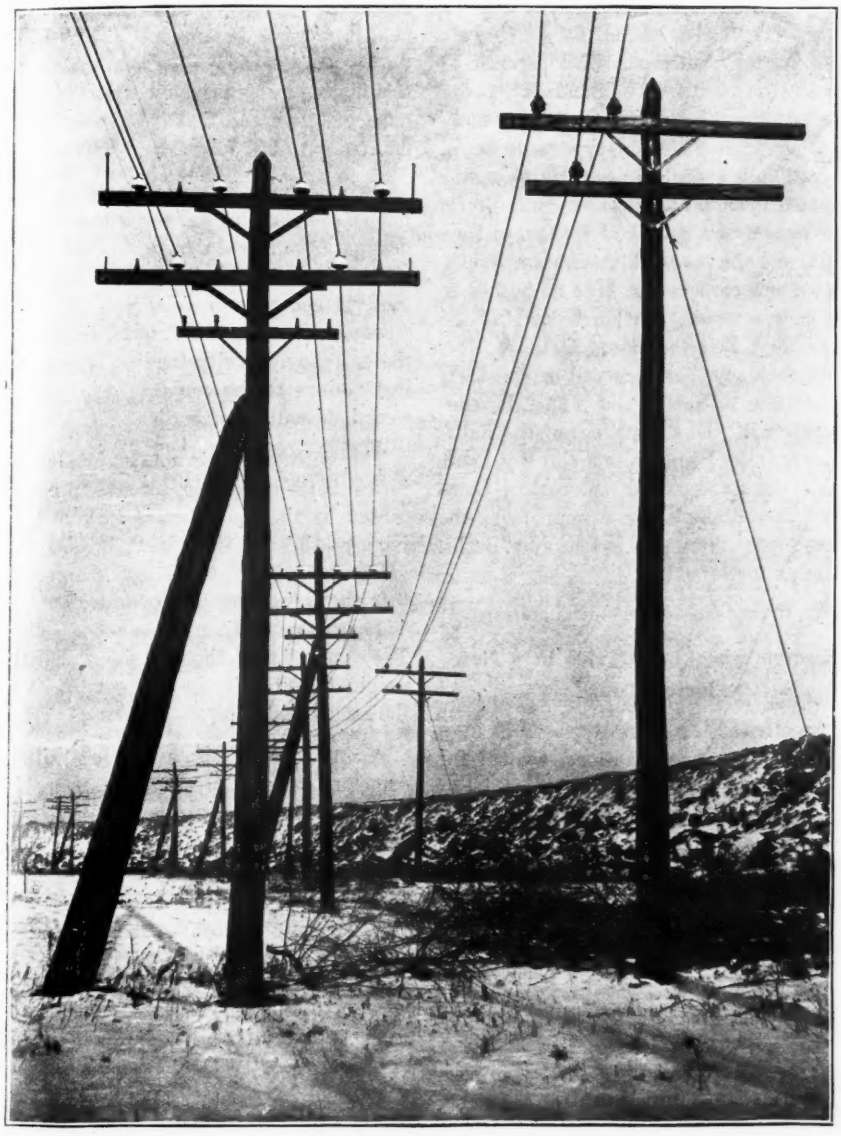
Press reports from Greenwood, British Columbia, state that eastern Canadian capital has purchased outright the Greenwood Electric Company and the Greenwood & Phœnix Tramway Company, and that $75,000 has been donated by shareholders in the two concerns. The tramway company is said to own a valuable charter obtained two years ago from the provincial government, giving it the right to build an electric tramway from Greenwood to Phœnix, Summit and Deadwood camps, with branch lines in the vicinity. This road, if built, threatens to become a serious competitor of the Canadian railway. The road, when fully equipped, will represent an expenditure of about $1,000,000.

A great jam and crowd on the Brooklyn Bridge marked the inauguration of the through electric elevated railroad service, in Brooklyn, N. Y., on January 21. Considerable confusion and much bad temper on the part of passengers were manifested on account of the new rules of the railroad company in dividing the through passengers from those for local stations. Passengers who only wanted to go across the bridge had to traverse the entire bridge station, passing to the extreme end toward Brooklyn before they could effect an entrance to the cars, and at six o'clock in the evening the single stairway at that end was so crowded that people were unable to move through the jam at all. The officials of the road state that as soon as the people come to understand the new rules they will be more easily accommodated and better pleased with the service than they ever were before.

THE NIAGARA FALLS POWER COMPANY'S NEW ALUMINUM TRANSMISSION LINE.

BY ORRIN E. DUNLAP.

The product of the Pittsburgh Reduction Company's plants in Niagara Falls and New Kensington, Pa., has made a very notable capture in winning the favor of the Niagara Falls Power Company, which



NIAGARA FALLS TRANSMISSION LINE—THE ALUMINUM LINE IS SHOWN AT THE RIGHT, THE OLD COPPER LINE AT THE LEFT.

company is now erecting a new power-transmission line between Niagara Falls and Buffalo, the cables on which are aluminum. This is the first aluminum adopted by this greatest of all power companies in any of its transmission schemes and as the new aluminum line is to work side by side of the present copper cable line, there will be an excellent opportunity to test the relative merits of the two metals as conductors.

When the Niagara Falls Power Company had developed a sufficient amount of power to take up the question of transmission, it built a pole line all the way from the Falls to Buffalo. On this line three bare copper cables, each containing 19 strands, were strung. Later this number of cables was doubled, so that to-day there are six copper cables on the line. This affords two three-phase transmission systems. The Niagara end of the line is in the big transformer station adjoining the central power station, and the Buffalo end is in the terminal station on Niagara street.

The new transmission line on which the aluminum cables are used extends between the same points. It follows the old line side by side until the south boundary of the village of Tonawanda is reached, and there, at the point where the transmission line crosses the tracks of the New York Central Railroad, it diverges from the old line and follows an entirely new right of way. This right of way is 30 feet wide and runs for nearly 15,000 feet along the west side of the New York Central to Ontario street, Buffalo. It then runs down Ontario street 7,000 feet to the terminal station. By taking this new route the new line is shortened by over three miles as compared with the length of the old line.

On the new line three aluminum cables are strung. The aluminum in these cables was made in the Niagara Falls works of the Pittsburgh Reduction Company, and the wire was drawn in the New Kensington, Pa., plant. In each of the aluminum cables there are 37 strands, which makes their diameter much greater than the copper cables on the old line. However, their conductivity is expected to be about the same. The lightness of the aluminum cable makes it possible to increase the span between the poles of the new line, and while the span on the old line is 75 feet, on the new line it will be 112 feet. This fact of itself is a great saving, for it lessens the number of poles in the construction.

At present Niagara power is transmitted to Buffalo at a voltage of 11,000, but as soon as the new line is completed, which will be within a month, the voltage on both lines will be made 22,000, or double what it is now. To bring about this change will not require any change in apparatus, for when the transformer installation was erected it was built for either 11,000 or 22,000 volts. When the voltage has been changed it will be possible for the Niagara Falls Power Company to transmit 30,000 electrical horse-power to Buffalo, and this amount of power will be ready for the Pan-American Exposition.

OBITUARY.

Otto W. Meysenburg, of Chicago, ex-president of the Siemens & Halske Electric Company of America, and of the Wells-French Car Manufacturing Company, died recently at Alma, Cal., of typhoid fever. Mr. Meysenburg was 52 years of age.

Thomas N. Fordyce, of Detroit, Mich., who leased the Miami & Erie Canal from the state of Ohio, is said to have placed a heavy order for electric motors to introduce electric traction instead of mule towage on the canal. The ultimate expense of the equipment will probably reach $500,000, and Mr. Fordyce's contract for the lease of the canal extends 30 years.

Massachusetts Electric Companies.

The Massachusetts Railroad Commissioners have sent to the Massachusetts House of Representatives their answers to the questions asked by Representative Bullock, of New Bedford, regarding the Massachusetts Electric Companies.

The commissioners state, according to the Boston *News Bureau,* that the Massachusetts Electric Companies is a voluntary association of owners of shares of stock in electric light and street railway corporations, and as such is not recognized by the board; but the companies in which the association owns shares issue no stock or bonds and effects no consolidation except under the supervision of the board and upon actual exhibit of corporate property and sworn statements of financial conditions.

The Massachusetts Electric Companies owns or controls the following companies: Beverly & Danvers; Lynn & Boston; North Woburn, Gloucester & Rockport; Lowell, Lawrence & Haverhill; Brockton Street Railway Company; Newport & Fall River Street Railway, and the Hyde Park Electric Company.

These companies represent through circulation 31 street railway companies in Massachusetts, of which one paid dividends of eight per cent previous to consolidation, two of seven per cent, six of six per cent, three of five per cent, two of four per cent, one of three and one-half per cent, three of three per cent, one of two per cent and 12 paid no dividends.

The Massachusetts Electric Companies has outstanding $15,075,000 four per cent preferred stock, $13,718,100 common and $2,700,000 four and one-half coupon notes. It only pays preferred stock dividends.

The Massachusetts Electric Companies is not subject to the anti-stock-watering laws, but such laws apply to the corporations in which it owns stock.

Canadian Electric Railway Statistics.

The statistician for the Dominion of Canada has compiled some interesting figures regarding the 34 electric railways of Canada. During the year ending December 31, 1899, he says, 630 miles of track were used and the total number of miles run by cars was 29,646,847. Passengers carried numbered 104,033,659, which was equal to carrying every man, woman and child in the Dominion 20 times. Compared with the previous year, the number of passengers increased nearly 9,500,000 and the number of miles run over 1,000,000. The amount of paid-up capital invested in electric railways in Canada is $21,700,000.

Norwalk, Ohio, As An Electric Railway Centre.

It is believed by local newspapers that within the coming year Norwalk, Ohio, will hold the most important place and be the greatest railway centre in all Ohio, having more lines centring and terminating in it than any other city in the state. In addition to the Sandusky, Milan & Norwalk road seven other roads have been incorporated and are in process of construction. The Toledo, Fremont & Norwalk road has been built and is in operation as far as Monroeville. The Sandusky, Bellevue, Monroeville & Norwalk line is making rapid progress and expects to be in operation by early Spring. Rights of way have been secured for the Cleveland, Elyria & Western road by way of Oberlin to Norwalk, and the Norwalk, Ashland & Southern, a new corporation, is to be pushed to an early completion. The officials of the Sandusky, Bellevue, Monroeville & Norwalk road say that they will extend their lines south to Shelby and Mansfield, connecting with the steam lines of the Baltimore & Ohio, Pennsylvania and Big Four, while the Sandusky & Interurban Company is contemplating a spur from the lake south through Ceylon and Berlin Heights to Norwalk.

Electric Shocking Device in a New Jersey Court.

An Italian on trial for assault in a New Jersey court recently disavowed the retraction of the assertion of the denial of the recantation of the confession of the falsity of the story he had told when examined before and denied that he had committed the assault for which he was held. To explain his conduct the man said that he had been given the "third degree" in open court, explaining his statement as follows. In front of the Recorder's desk is a brass rail which can be electrified as the justice desires. The judge in question had been greatly annoyed by the familiarity of prisoners, who would lean against his desk and whisper or make themselves otherwise offensive. The rail had never been used deliberately to force a confession until this Italian was shocked, though it had been the cause of much amusement to the court habitués when used on some prisoner who was too lazy or tired or drunk to stand up in a proper manner. The Italian stated that his confession was extorted from him by the electric rail, but notwithstanding his protests of innocence the jury found him guilty as charged.

LEGAL NOTES.

A contract embodied in telegrams is held, in Brewer *vs.* Horst-Lachmund Company (Cal.) 50 L. R. A. 240, to be sufficient under the statute of frauds. The case is accompanied by a note reviewing the other authorities on this question.

An ordinance intended to prevent or remedy an abuse of the street-railway transfer system by making it unlawful to give away or sell any such transfer, is upheld in *ex parte* Lorenzen (Cal.) 50 L. R. A. 55, against the contentions that it attempts to enforce private contracts by penal legislation and that it is an unlawful deprivation of property.

An agreement by the agent of a telephone company to deliver a message at destination in consideration of an extra charge is held, in Brown *vs.* Cumberland Telephone and Telegraph Company (Tenn.) 50 L. R. A. 277, to be binding on the company, notwithstanding the agent's instructions to the contrary, where these were habitually disregarded.

The right to sue in one action for injuries both to person and to property caused by the same tort is sustained, in King *vs.* Chicago M. & St. P. R. Company (Minn.) 50 L. R. A. 161, on the ground that the claims are but separate items of damages constituting one cause of action. The annotation to the case shows that the weight of authority in this country is to the same effect.

A municipal grant to a street railway company of the privilege of using its streets for the conveyance of electricity is held, in Clarksburg Electric Light Company *vs.* Clarksburg (W. Va.) 50 L. R. A. 142, to constitute a valid franchise and contract within the protection of the federal constitution; but an attempt to make such franchise exclusive was held void. The annotation to this case reviews the authorities on the privilege of using streets as a contract protected by the constitution.

Edison Electric Illuminating Company of New York.

The annual meeting of the stockholders of the Edison Electric and Illuminating Company of New York city was held at that company's offices, No. 53 Duane street, on February 13, 1901, to elect 13 directors for the ensuing year and three inspectors of election to serve at the next annual meeting, and also for the purpose of transacting such other business as may properly come before the meeting. The entire board of directors was reelected.

Electric Lighting

An electric lighting system will soon be installed at Gary, Minn.

The board of public works of Waterbury, Ct., has recommended that the aldermen be empowered to issue bonds for $100,000 to install an electric light plant.

A mortgage for $100,000 has been placed on the plants of the Bath, N. Y., Electric Light and Power Company and the Bath Gas Company, both of which are under one management.

W. E. Herwick, of Akron, and G. A. Dodge, of Talmage, Ohio, are said to have filed an application with the Wadsworth village council for a franchise to erect an electric lighting plant in that city.

The plant of the Texarkana, Tex., Gas and Electric Light Company was recently destroyed by fire, the loss inflicted reaching about $15,000. J. L. Griffith is the manager and J. J. Conley is the chief engineer.

About 40 of the business men of Fond du Lac, Wis., have organized a stock company to install a new electric lighting plant. The company will be incorporated for $10,000, with a paid-up working capital of $5,000.

A bill was recently introduced into the legislature of Augusta, Me., to incorporate the Wilton Electric Light and Power Company, with a capital stock of $10,000 and the right to increase this amount at any time up to $100,000.

It is reported that the local Edison Electric Illuminating Company has withdrawn its offer of a lease to the Boston, Mass., Electric Light Company, on a 10 per cent basis, as the Morgan syndicate has not yet released the latter company.

A further concession of $60 a year for arc lights is said to have been made to the city of Denver, Colo., by the present lighting company, which desires, if possible, to force the hand of the Lacombe company in order to prevent it from entering the field.

Bids are being requested by the Spanish officials of Ayamonte, in Seville, for the electric lighting of that town, the concession being for 20 years, and the lighting power required by the municipality for its own use is 2,250 candles. The upset price is said to be 7,500 pesetas.

Specifications for lighting the city of Albany, N. Y., have been completed and the interests of the city are said to have been guarded in a very careful manner by the board of contract and supply. The period of the contract is for five years between June 21, 1901, and June 21, 1906.

By reason of the recent rise in the price of coal the money appropriated for the running expenses of the electric light plant in Washington, Ind., has been found inadequate and it is now estimated that to run the plant in first-class shape will cost the city from $4,000 to $5,000 a month more than it gets for private lighting.

The Rochester, N. Y., Gas and Electric Company has purchased the Hinds flour mill property in that city and is expected to be an enterprising competitor of the Citizens' Light and Power Company, which is said to have been purchased by a strong syndicate, prominent among whose backers are Messrs. William K. Archbold, Paul T. Brady and Alden M. Young.

Mayor J. M. Head, of Nashville, Tenn., is said to be connected with a commission which is in charge of the construction of an electric light plant for that city for which $150,000 will be expended. Plants were visited by Mayor Head in order to enable him to determine exactly upon what Nashville ought to have, and among those seen were the one at the Westinghouse works and the large lighting stations in Pittsburgh and Allegheny.

Reports from Philadelphia, Pa., state that the United Gas and Improvement Company purposes to operate the several plants of the Connecticut Railway and Lighting Company by power generated on the Housatonic River in that state, and transmitted at high voltage to the various stations in the system. The gas company is said to own the entire stock of the other company, and it is believed that a great saving in operating expense can be secured by obtaining power in that manner.

The directors of the Edison Electric Illuminating Company, of Westchester, Pa., recently purchased a large plot of land in that town in order to erect upon it a much larger building than it at present occupies. The demands made upon the company at the present time are so great that it is unable to care for every one, but it is thought that when the new building is finished and adequate machinery installed there will be no difficulty in handling all the business that comes to the company.

"At the last session of the West Virginia Legislature $8,000 were appropriated for an electric light plant for the capitol building and grounds," says the Governor's message for the present session. This plant has been in operation for perhaps a year and has been found satisfactory to the officers and clerks in the building itself, but as the one dynamo is insufficient the Governor recommended that a committee be appointed to investigate and report as to the advisability of installing another one of equal voltage.

Street lighting by electric arc lamps in Paris, France, is said to be making considerable headway and that in consequence of this gas lighting has to a large extent been discontinued in many of the more important streets, among which is the Rue de Rivoli, from the Louvre to the Hotel de Ville. The charges for arc lighting at the present time are said to be excessive but it is believed by those acquainted with the situation that the municipality will eventually acquire the lighting enterprises, thereby largely increasing them and reducing the cost.

The recent statements in New York papers that telephone operators have been greatly annoyed and in some cases injured by the flashing of the tiny lamps on the switchboards are said to be entirely unfounded. One of the young women is said to have fallen senseless before her board and her illness was attributed to the fact that the lights had been substituted for the buzzers previously used. Just what the permanent effect of the lamps will be is not known so far but it is not believed that the lamps had any real connection with the accident to the young woman mentioned, who would probably have been ill in any case.

According to recent notices given out by the City of London, England, Electric Lighting Company, Ltd., until further notice by public advertisement the rates for electricity will be as follows: During the March and December quarters up to and inclusive of the first six units per eight-candle-power lamp or its equivalent, 16 cents per unit will be charged, and for all current consumed in excess of that four cents per unit will be charged. During the June and September quarters up to and including the first three units per eight-candle-power lamp or its equivalent, 16 cents will be charged, and all current in excess of three units per eight-candle-power lamp four cents will be charged.

New Home of the Automobile Club of America in New York.

Since its organization the offices and rooms of the Automobile Club of America have been in the Waldorf-Astoria Hotel, in New York city. On February 16 the new club rooms were thrown open to the members. The premises are situated in Fifty-eighth street and the Plaza, having a frontage of 37 feet on Fifth avenue.

The interior of the building is decorated mainly in automobile red, the portières, draperies and upholstery all being harmonic blends of the same color. The furnishings are solidly elegant. On entering the rooms the noticeable feature is a large window commanding a view up and down Fifth avenue for several blocks and almost facing the entrance to Central Park. In a corner of the main room is the library, which is done in green, while on the other side of the office is another large room set as a Dutch apartment with a gas grill at one end, and fittings of an old style Holland type. The ceiling, which is of red, is lined with heavy black iron beams and large tiles of the same color are set in the floor. Delft blue wall paper and heavy ebony woodwork aid in presenting an antique appearance that is further emphasized by the massive Dutch chandeliers in black lacquered iron. Lockers of the same dull hue in wood are provided for the members along one side of the apartment, while beer steins and clay pipes on shelves and racks carry out the design. The illustration is presented by courtesy of the New York *Herald*. The club enters its new premises with an active membership of more than 300, 65 per cent of whom own and operate their own vehicles, several of the members possessing more than one machine.

The topic of conversation at the reception, which was held on the opening of the new rooms, was the proposed speed legislation in the state of New York and the coming endurance contest between New York and Buffalo in the Autumn. The officers of the club stated emphatically that they are positively opposed to high speeds on public highways and that the run to Buffalo would be simply a contest to determine the endurance of the competing vehicles and to illustrate their earnestness in that matter the law committee of the club has had provided a bill to regulate the speed of automobiles through the state and which has been introduced at the present session of the legislature. In a general way the vehicles which will take part in the contest will be classified by weight; those weighing 1,000 pounds or less being put in one class, those between 1,000 and 2,000 pounds in the second, and those above 2,000 pounds in the third. Some of the members are said to have contended that a fairer way of determining upon the classes is to divide the machines according to cost, horse-power and cylinder volume. The competition for the prizes will be very keen, and the contestants will represent most of the nations of Europe and every section of the United States. The roads between Buffalo and New York are soon to be examined and the best possible route selected. Stations will then be designated for the storage of fuel and electric batteries and arrangements made for the accommodation of the contestants at the various stopping places where each day's run ends. Elaborate records of each machine run will be kept, an observer being assigned to each vehicle who will note every delay or stop, the breaking of a bolt, loosening of a nut or other slight accident, all of which must be fully explained. From these records it is believed that many valuable and instructive lessons in automobile building and handling will be drawn. The contest will end in the Stadium of the Pan-American Exposition in Buffalo.

The Independent Telephone Plant at Akron, Ohio.

The independent telephone plant installed at Akron, Ohio, by the Akron Peoples' Telephone Company was formally opened for business on December 1, 1900, and was preceded by a public reception the afternoon and evening before. Service had been given the subscribers for some time and all were familiar with the working of the system as far as the subscribers' telephones were concerned, but on the opening day the public was invited to the exchange to see the operating of the central office equipment. The interest taken by the business men of Akron in the independent exchange was exceptionally large

Reception Room in the New Quarters of the Automobile Club of America, New York City.

An Institute Conversazione.

The council and committee on meetings of the American Institute of Electrical Engineers have arranged for a conversazione to be given by that body some time in April. Through the courtesy of Columbia University, the conversazione will be held in the electrical engineering department, with the cooperation of Dr. Pupin, Professor Crocker, Professor G. F. Sever and others of the staff there. While the conversazione will be largely social in character, a special feature will be the exhibition of latest electrical apparatus, inventions, etc., in working order. Mr. T. A. Edison, Professor Elihu Thomson, Dr. Pupin and others have promised personal assistance in this respect. Secretary Pope and Mr. W. S. Barstow, chairman of the papers and meetings committee, extend through the press an invitation to all members to contribute features of scientific interest and to give early notification of what they will do in this respect.

and was shown by the thousands that attended the reception and carefully examined the switchboard. The rooms were beautifully decorated with flowers, ferns and palms, and the stars and stripes were prominently displayed.

Fig. 1 shows one side of the operating room with the switchboard. The equipment, furnished by the Stromberg-Carlson Telephone Manufacturing Company, of Chicago, is of the central energy multiple switchboard type. The board has a capacity for 3,000 subscribers and was equipped originally for 1,200 and later increased to 1,800 lines. The board is provided with visual signals as line indicators, which rise into view of the operator automatically when a subscriber takes the receiver from the hook. The signal is restored when the operator inserts the plug for answering the call. Each operator is within reach of a jack connected with every line in the exchange, enabling

the making of a complete connection between any two subscribers. Simultaneously with the indicating of the line signal, a pilot lamp is lighted underneath the answering jacks in the centre of the position immediately above the plug itself. The connection is made in the usual manner.

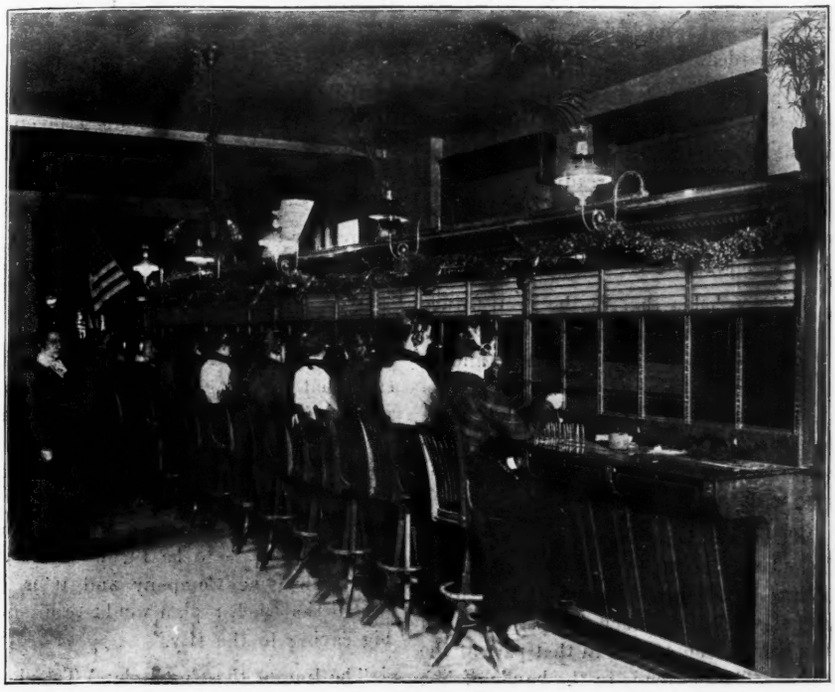


FIG. 1.—THE SWITCHBOARD IN THE INDEPENDENT TELEPHONE EXCHANGE AT AKRON, OHIO.

The board is provided with an efficient busy test so that any one operator may readily know if any line is busy on any other part of the board. When a line is busy, the operator receives a faint click in the receiver when touching the shell of the spring-jack with the tip of the plug. Every detailed part of the equipment is made strong and durable and is mounted in a heavy iron frame, which is well braced to make it strong and rigid. The framework is neatly covered with well-finished and highly polished quarter-sawed oak.

Fig. 2 shows the other side of the operating room, with the chief operator's desk and the toll-line switchboard. The chief operator's desk is equipped with complete operator's instrument, proper connecting cords, plugs, weights, ringing and listening keys and clearing-out signals. It is provided with line signals, etc., for lines connecting with the various parts of the offices and also a monitor jack with each operator's position. It is also provided with three sets of miniature lamp signals connecting with each operator's position; one lamp indicates when the subscriber has signaled the central office and the lamp remains lit until the operator answers the call. The second set of lamps is for indicating when the subscribers have replaced their receivers and remains lighted until the operator makes the disconnection. The third set is for indicating when the operator calls subscribers and the lamps are lighted while the operator is ringing the subscriber's instrument.

FIG. 2.—CHIEF OPERATOR'S DESK AND TOLL-LINE SWITCHBOARD IN THE INDEPENDENT TELEPHONE EXCHANGE AT AKRON, OHIO.

The toll board shown is arranged for three operator's instruments and for connecting 45 toll lines or country party lines. This board is for making connection between the large number of toll lines centering in the office and with the exchange and country party lines. Any subscriber in the central energy exchange can make direct connection with any long-distance toll-line system throughout the state and connecting lines.

The desks are neatly designed and substantially constructed. The outside construction work of the exchange is of the highest standard; nothing but the best material obtainable was used and put up in the best manner possible.

The company was originally organized with a capital of $50,000 and when the exchange was started the capital was increased to $200,000, which was recently increased to $500,000 to extend the plant throughout the adjoining territory. The officers of the company are Will Christy, president; E. J. Clapp, vice-president; A. B. Conklin, secretary; J. R. Nutt, treasurer, and F. G. Frese, general manager, all of whom are heavily interested in other large telephone exchanges as well as many other lines of business. The Akron plant is considered to be one of the best independent telephone exchanges in the state of Ohio.

New England Lighting Situation.

Reports from Boston, Mass., say that the directors of the Edison and Boston Electric Light companies are again discussing consolidation. The basis of the association is to be somewhat like the plan proposed by the Morgan syndicate regarding the interest return of 11½ per cent and 10 per cent respectively to the Edison and Boston company stockholders. The combination, however, will be more in the nature of an affiliation of friendly interests rather than a lease by a third company.

Telephone and Telegraph

A new telephone exchange will soon be put in North Lewisburg, Ohio, by the Bell Telephone Company.

A new telephone system is being installed in the town of Monmouth, Ill., by F. L. Bills, of the Union Telephone Company.

Press reports from Minneapolis, Minn., state that the telephone exchange in Albert Lea has recently been sold for $10,000 to S. H. Cady.

A franchise was recently granted in Wellsville, N. Y., to the Wellsville Telephone Company, which will operate at first a purely local system.

A franchise has been granted by the town of Jackson, Mich., to the United States Telephone Company (whose headquarters are at Cleveland, Ohio) to run a toll line into Jackson.

A recently chartered corporation in South Dakota is the Woonsocket Telephone Company, whose capital is $2,500 and whose incorporators are E. M. Smith, J. C. Whiting and others.

J. C. Rogers, of Hartselle, Ala., manager of the long-distance and interested in the local telephone system, is reported to have sold out to two capitalists who took charge of the exchange on February 1.

A charter has been applied for by the Schuylkill Valley Telephone and Telegraph Company, of Pennsylvania, at Harrisburg. The company wishes to compete with the Pennsylvania Telephone Company.

It is announced that the plant of the Citizens' Telephone Company, Terre Haute, Ind., will be in operation within 60 days. The company is said to have been offered $75,000 for its plants and franchises, but refused to sell.

Work is progressing rapidly on the new building of the New England Telephone Company, on Concord street, Manchester, N. H. The new edifice is stated to be a model for convenience and is rated as one of the best in the company's service.

By order of the general council of Louisville, Ky., the local telephone franchise was sold at public auction recently to E. M. Coleman for $10,000. Mr. Coleman was the only bidder and states that he will start an independent company.

Financial arrangements for the Indianapolis, Morristown & Rushville, Ind., Traction Company are said to have been completed, and the contract for the construction of the road from Indianapolis to Rushville and from Morristown to Shelbyville awarded.

If present expectations are realized the East Side Telephone station, at the corner of Sixth and East Grand streets, in Des Moines, Iowa, will be ready for business about the last of February, thus making room in the West Side exchange for about 250 more subscribers.

It is probable that in the near future the Trunk Line Telephone Company, of North Henderson, Ill., will have an exchange in Galesburg, as many farmers north of that city are said to be extremely anxious that the arrangement shall be made so that they easily could communicate with the city.

Plans are being made by the Dixie Telephone Company, of Winchester, Tenn., to offer the citizens of that town and the vicinity a much cheaper rate than has before been offered in that part of the state. The matter is in the hands of Mr. J. L. Haynes, Jr., who is actively pushing the matter to a conclusion.

An entire reorganization has been voted in the management of the Automatic Telephone Company, of Seattle, Wash., and an application has been filed by the company to begin work. The officers of the new company are E. A. Seeley, president; A. E. Edwards, vice-president; A. E. Adams, treasurer, and Frank B. Ingersoll, secretary.

The Diamond State Telephone Company, of Dover, Del., is said to have recently purchased the telephone line between Hepbron Station, on the Baltimore & Delaware Bay Railroad, Stillpond and Betteron. This will give the two towns last named direct communication with Baltimore, Philadelphia, Wilmington and Washington.

The annual meeting of the New York & New Jersey Telephone Company will be held in Brooklyn, N. Y., immediately after the special meeting which will be held in the same city, on March 1, to consider an increase in the company's stock from $8,000,000 to $15,000,000. This increase will be used from time to time for new construction work.

Press reports from Hazleton, Pa., state that a local jeweler by the name of Stephen Engle has invented a telephone transmitter which experts are said to believe will greatly lessen the cost of equipping telephone plants. Mr. Engle claims that he can make his transmitters as small as thimbles and that when manufactured in wholesale the cost will be scarcely a cent apiece.

It was recently decided by the directors of the Chicago, Ill., Telephone Company to issue $1,000,000 in new stock sometime during April. It will probably be delivered on April 8 at par to shareholders of record of March 27, and will bring the figures for outstanding stock at that time to $8,000,000. It is also believed that an additional million will be issued sometime in October.

Newspaper reports from Buffalo, N. Y., state that a number of West Side business men of that city have taken up the matter of a municipal telephone exchange and have in preparation maps for such a plant, proposing to substitute "a private municipal exchange to connect with all the schools. This is to be furnished by the Bell Telephone Company and it is expected that such a plan would result in a big saving to the city."

The line of the Cumberland Telephone Company between Greenville and Palmyra, Ky., has been completed and communication can now be made between the New Albany exchange and all towns on the Paoli Pike as far north as Fredericksburg. The company is said to have over 850 subscribers at present and will soon extend its toll lines to Hardinsburg, where it is anticipated that a number of new subscribers will be added.

Dallas, Tex., is the scene of considerable agitation for an independent telephone system to compete with the Southwestern Telephone Company and several conferences have been held between the leaders of organized labor bodies, members of the board of aldermen and some of the municipal executive officers with a view to granting a franchise for the establishment of such a company to a corporation whose organizers are laboring men. The matter is said to have created considerable interest.

Reports from southern Iowa state that Mr. J. C. Hubinger has sold all his telephone property in the southeastern portion of the state to Charles Randall, of Chicago, Ill., who is believed to represent the Royal Trust Company, of that city. The transfer is stated to be absolute and the consideration $40,000. The telephone exchanges included in the deal are Montrose, Keokuk, Fort Madison, Weaver, Mediapolis, Wapello, Burlington, Fruit-

land, Grand View, Muscatine and Columbus Junction.

A judge of the circuit court, of Kansas City, Mo., recently handed down an opinion in a case which is considered of national importance, when he decided that the state of Missouri, represented by the state board of equalization, had no legal rights to tax the franchises of the Western Union Telegraph Company. Prior to Judge Henry's decision the board had practically doubled the first valuation of the company's actual property and added the words "and on all other property, $862,000." It was this addition that caused the company to contest the matter.

A New Common Battery Telephone.

What is practically a new central telephone exchange has been installed by the New York & New Jersey Telephone Company in Newark, N. J. The principal improvements inaugurated by this change will be that the patrons of the system no longer have to ring up the central office, as when the receiver is taken from the hook it lights a lamp on the switchboard, thus informing the operator of a call. The cables of the system terminate at the present time in the distributing rack, which accommodates 6,000 wires or 3,000 circuits, and has an ultimate capacity of 5,000 circuits.

Farmers in the northern part of Henry County, Ind., have decided that they will not be without urban improvements, and sometime ago united to form a telephone company. Four other companies were formed in quick succession in the same neighborhood and the five operated separately for a time, at length forming a pool of their respective lines and putting in a complete plant to serve the patrons of the several companies. The subscribers of the company furnished their own poles and did the construction work themselves, so that the line complete, including a telephone in each house, cost them about $15 apiece. The farmers in the county are said to be very enthusiastic over the success of their experiment.

The Delaware & Atlantic Telegraph and Telephone Company, of Atlantic City, N. J., recently gave what is stated to be a very impressive exhibition of the wonders that long-distance telephony is able to perform. Forty-five gentlemen gathered in the private office of Manager Joseph Engelke and listened to the intermezzo from Cavalleria Rusticana, as played by the Palmer House orchestra, in Chicago, Ill.; the noise made by a heavily laden truck toiling up Beacon street, in Boston, Mass., and the creaking of blocks and tackle as the nets off the end of Young's Pier, in Atlantic City, were hauled out of the water. It is stated that the sounds which came from Chicago and Boston were, if anything, more clearly distinguishable than those which originated a few blocks away. The plant of the company is said to be singularly complete and is reported to be one of the best in the state.

A New Common Battery Telephone.

There is being placed on the market by the Couch & Seeley Company, of Boston, a telephone for common battery exchanges of unique design and which seems to embody some especially desirable features.

The back of this telephone is a hollow casting, highly finished in black, handsomely striped, this being mounted on a one-half inch oak backboard as shown in the illustration. The space between this backboard and the front plate of the casting is sufficient for mounting a condenser, which is manufactured by the same concern. The ringer is attached as shown, and when the shelf is raised this ringer tips forward on hinges so that it is accessible for any adjustment or other attention which may be necessary. This also opens up the entire box in such shape as makes it easy to reach the hook contacts, induction coil and all parts. The cabinet work is finished in oak unless specially ordered.

This telephone is equipped with the makers' long-distance, coal grain microphone and bipolar receiver, both of which are too well known to require detailed information at this time. They are covered by a standard guarantee against deterioration for five years.

The makers have been furnishing this common battery telephone to a limited number of exchanges for some time but have not placed it on the open market heretofore because they wished the instrument to be given a thoroughly practical test from every standpoint. Changes have been made since putting out the first instruments of this type, which, while not increasing their efficiency, have simplified the construction and arranged all parts in such a manner as to make them especially accessible to the inspector. The makers are now placing this instrument on the market as their standard type and will be glad to supply detailed information to any one interested in this type of instrument. The various forms of desk sets are also made for common battery purposes and for use on any of the various common battery systems employed.

Corporation News

ST. PAUL, MINN.—Albert Lea Telephone Company. $50,000.

COLUMBUS, OHIO — Wadsworth Light and Water Company, of Wadsworth. $50,000.

LANSING, MICH.—Homer Electric Light and Power Company, of Homer. $14,000.

COLUMBUS, OHIO—Ashley Telephone Company; $6,000. Winona Central Telephone Company; $10,000.

ANSONIA, CT.—The Ansonia Telephone Company has increased its capital stock from $20,000 to $25,000.

ALBANY, N. Y.—Adams Construction Company, of Buffalo. $5,000. J. O. Munroe and others, directors.

JEFFERSON CITY, MO. — Mercantile Electric Company. $100,000. Directors: G. Swope, I. Schwab, F. Uhrig and others.

MILWAUKEE, WIS.—Southwestern Telephone Company. $5,000. Incorporators: G. Lorig, W. J. Sutton and F. J. Koch.

ZANESVILLE, OHIO — Zanesville Telephone and Telegraph Company has increased its capital stock from $10,000 to $200,000.

AUSTIN, TEX.—Wichita & Charlie Telephone Company. $15,000. Incorporators: W. D. and D. E. Bentley, H. T. Dunn and others.

COLUMBUS, OHIO—Columbus Battery and Specialty Company. $10,000. P. B. Chavey, J. W. and G. W. Frost and others, incorporators.

ST. PAUL, MINN.—Hutchinson Telephone Exchange Company. $25,000. M. W. and W. S. Clay, E. J. Stearns and others, incorporators.

ST. PAUL, MINN.—The Mankato Citizens' Telephone Company has amended its incorporation articles and increased its capital stock to $100,000.

RALEIGH, N. C.—Durham Traction Company. $1,000,000. In connection with its street railway lines the company will operate an electric lighting plant.

BALTIMORE, MD.—The plant of the Port Deposit Electric Light Company was recently sold to P. E. Tome, of Baltimore, for $2,000, subject to a mortgage of $15,000.

ALBANY, N. Y.—Hunter Fan and Motor Company, of Fulton. $100,000. The directors are J. C., Thomas, William, Robert B., John, Samuel and Mary E. Hunter.

TRENTON, N. J.—Consumers' Electric Light and Power Company, of Haddonfield. $100,000. W. D. Sherrard, W. S. Wright, A. R. Underdown and others, incorporators.

INDIANAPOLIS, IND.—Plymouth Electric Light Company. $10,000. Connersville Traction Company. $25,000. Greensburg & Versailles Traction Company. $10,000.

SPRINGFIELD, ILL.—National Electric Security Company, of Peoria. $30,000. To manufacture burglar alarms, etc. Incorporators: John Bontges, W. Donaldson and C. E. Unland.

WILMINGTON, DEL.—Alaska Townsite and Telephone Company, of New York. $1,000,000. The object of the company is to manage telephones and telegraphs and hold real estate.

MILWAUKEE, WIS.—An increase of stock has been certified to by the Milwaukee Electric Company, the addition being $90,000. This brings the capitalization of the company to $150,000.

TRENTON, N. J.—Electric Railway Equipment Company, of Camden, N. J. $25,000. Incorporators: W. H. Heulings, M. H. Brill, A. S. Vane, of Philadelphia, and G. Sherrard, of Haddonfield.

LOWELL, MASS.—A company soon to be incorporated is the Lowell & Southern New Hampshire Railway Company, which will be incorporated for $40,000 by W. H. Anderson, A. J. Ryan, G. A. Richardson and others.

INDIANAPOLIS, IND.—Elkhart Electric Company, of Elkhart. $100,000. J. L. Dodge, C. F. Hewitt and D. U. Shane, incorporators. The Plainfield Telephone Company has increased its capital stock to $10,000.

AUSTIN, TEX.—Austin Telephone Company. $100,000. Incorporators: J. E. Boynton, J. B. Earle, of Waco; C. H. Rose, of Columbus, Ohio; J. S. Bailey, of Wauseon, Ohio, and G. H. Baker, of Defiance, Ohio.

ALBANY, N. Y.—Yonkers & White Plains Railroad Company. $50,000. Directors: Freeman H. Merritt, W. J. Wilson, H. D. Dent and others. The road will operate an electric line between Yonkers and White Plains.

ALBANY, N. Y.—Norwich Gas and Electric Light Company, of Connecticut. $100,000. This company is a branch of the Union Water, Light and Power Company, of East Orange, N. J., which operates plants throughout New York state.

INDIANAPOLIS, IND. — Bloomington Light, Heat and Power Company; $10,000; directors: S. V. and A. G. Perrott and H. C. Ulen, Jr. Bedford Light, Heat and Power Company; $100,000; directors: A. C. and J. R. Voris and I. N. Glover.

LANSING, MICH.—Detroit & Chicago Traction Company. $4,000,000. Incorporators: W. A. Boland, of Grass Lake; W. A. Foote, of Jackson; P. H. Flynn, J. McHenry, F. C. Cochran and I. W. McLay, of New York, and G. J. Corr, of Jersey City.

CHATTANOOGA, TENN.—The Chattanooga Light and Power Company has applied for an amendment of its charter in order to increase its capital stock about $100,000 to improve its system. The contemplated increase will bring the figures up to $250,000.

REDWOOD CITY, CAL.—A company will soon be formed in this city to build an electric road in San Mateo County from Redwood City to San Gregorio *via* La Honda, and will probably be extended, if successful, to Big Basin. The capital stock will be $450,000.

HEMPSTEAD, L. I.—A mortgage for $150,000 has been filed by the Hempstead Gas and Electric Light Company, in Queens County, payable in gold on February 1, 1931, or at the option of the company 10 years after date of the mortgage, which is dated February 9, 1901.

BOSTON, MASS.—New Bedford & Onset Street Railway Company. $200,000. Directors: Henry H. Crapo, Thomas B. Tripp, Joseph K. Nye, of Fairhaven; Charles S. Mendall, of Mattapoisett; Charles W. Ripley, of Marion; William E. C. Warr and Edward G. Parsons, of Wareham.

TRENTON, N. J.—Portable Electric Light and Power Company. $250,000. Incorporators: T. P. Morgan, D. T. McLaren and J. W. Tompkins, of Jersey City. Within a few days a company to be known as the Woodbury & Woodstown Railway Company will be chartered with a capital stock of $450,000.

JEFFERSON CITY, MO. — The Sedalia Street Railroad has been sold under foreclosure proceedings of first mortgage bondholders of the Kansas City Loan and Trust Company, and second mortgage bondholders of the Trust Company of America, of New York, judgments having been given for $218,363 and $53,809.

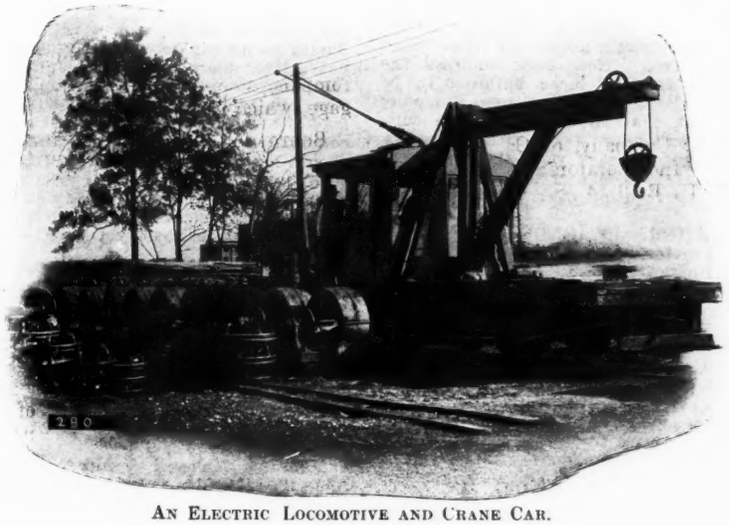
BOSTON, MASS.—Berkshire Street Railway Company. $1,000,000. To build an electric road from the terminus of the Hoosac Valley line, in Adams, south through Berkshire County to the Connecticut line. R. D. Gillett, of Pittsfield, Mass., is said to be at the head of the syndicate. W. E. Tillotson, of Pittsfield, is also interested.

The engineer for the Pittsburgh, McKeesport & Connellsville, Pa., Traction Company, Wilbur D. Chapman, proposes to construct new Connellsville lines in the near future, at a probable cost of about $2,000,000. Mr. Chapman's plans are not yet complete, but the 80 miles of new road required will be mostly short pieces to connect up the present merged roads of the system. The lines to be constructed will be between Uniontown and Fairchance, Connellsville and Scottdale, and between Scottdale, Buena Vista and Mt. Pleasant.

An Electric Locomotive and Crane Car.

An interesting and useful piece of machinery is the combination electric locomotive, flat car, crane and wrecking outfit illustrated in the accompanying engraving.

The machine is made for operation on circuits of 110, 220 or 500 volts, a double-trolley system being used to avoid grounding one side of the circuit. As the principal use of the combination is in the yards of works and factories, where it is not always desirable to maintain grounded circuits, it was concluded by the makers, the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, to design the machines for double-feed circuits.



AN ELECTRIC LOCOMOTIVE AND CRANE CAR.

The locomotive is provided with a jib crane having an extensible arm, so that the radius of operation may be varied. With a 10-foot radius the crane will handle 10,000 pounds. This will provide for about as large a single piece as the average manufacturing business has to contend with. The height of the top of crane from top of rail is 13 feet 6 inches. The jib can be used at either side of the car, and the movement of the arm is controlled by the operator within the cab. Cars set upon a track parallel to the one upon which the crane car stands may be loaded and unloaded. The capacity of crane, either in lifting power or radius of work within certain limits, may be made to suit the requirements of manufacturers.

There is available a space 14 feet by 9 feet 6 inches upon which may be loaded material for transfer from one part of the works to another. This feature of the car renders it a great convenience and the entire load can be handled by the crane, the work of loading and unloading being quickly accomplished. The capacity of the car is 40,000 pounds.

The side trusses of the car are made of cast iron of especial heavy construction to provide weight for tractive effect and as a counterbalance for the crane. The centre of gravity of the car is therefore low down and well distributed. Regular 33-inch steam railroad car wheels and axles are used with a nine-foot wheel base. This permits of the car taking curves too short for an ordinary steam locomotive. The car body is 22 feet in length over all and 9 feet 6 inches wide. While the dimensions of the crane, either in lifting power or the radius of the work within certain limits, will be changed to suit the requirements of the purchaser, there is but one dimension of car body as stated. The height from top of rail to top of crane is 13 feet 6 inches.

The cab is provided with sash on all sides, permitting the operator to see in all directions. It contains the controller from which the propelling motors are operated, a brake, a main switch from trolleys and main-line fuse-block; also controllers for the hoisting and swinging motors for the operation of the crane.

Wall Street and the Electrical Stock Market.

On the New York Stock Exchange, General Electric closed the week at 210½ bid and 211 asked, indicating a gain of 14½ points. A sensational advance occurred in this stock on Thursday. It opened at 198¾ and ran up on total sales of 6,300 shares to 215, closing at 211½, or at a net gain compared with Wednesday's close of 12½ points. It was reported that there is a plan under consideration to increase the capital stock to the amount at which it stood prior to August 17, 1898, when the stock was scaled down 40 per cent from $34,712,000 to $18,276,000 common and $2,551,000 preferred stock. Last July the stockholders voted an increase of $4,415,000 in the common stock for the purpose of retiring the debentures. The company's earnings are believed to be enormous. A report from Boston says that directors of the company profess ignorance of any plan under consideration for a restoration of the capital stock to the amount at which it stood prior to August 17, 1898, when the stock was scaled 40 per cent from $34,712,000 and common was reduced to $18,276,000. Bond exchanges have now increased the common to about $21,000,000. They say that such a plan could not be put into effect without the new stock being paid for by surplus or new money.

A rumor, circulated on Thursday, that the Western Union and Postal Telegraph companies would consolidate, was quickly contradicted.

Metropolitan Street Railway, of New York, closed at 163¾ bid and 163 asked, showing a gain of ½ point. Brooklyn Rapid Transit closed at 77 bid and 77⅛ asked, showing a loss of 1¼ points for the week. Third Avenue Railroad closed the week at 121 bid and 122 asked, showing no change in either price. Manhattan Railway, of New York, closed at 117⅜ bid and 118 asked, indicating a loss of ⅞ point.

On the Boston exchange, American Telephone and Telegraph closed at 162 bid and 163 asked. Erie Telephone closed at 62 asked and no bid price quoted, indicating a loss of 1 point in the asked price. New England Telephone was not quoted.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed the week at 8 bid and 8½ asked, showing no change. Union Traction closed at 34¼ bid and 34½ asked, indicating a loss of ½ point for the week.

On the curb, or outside market, in New York, Electric Vehicle closed at 15½ bid and 16½ asked, showing no change. Electric Boat closed at 26 bid and 28 asked, showing a loss of 1 point. Consolidated Equipment closed at 9½ bid and 9¾ asked, showing no change for the week in the bid price and a loss of ¼ point in the asked price.

Wall street, February 16.

The Winchester Avenue Railroad, of New Haven, Ct., was compelled to stop running cars on February 16 because in the morning of that day its power-house was completely destroyed by fire.

Industrial Notes

THE INTERNATIONAL CORRESPONDENCE SCHOOLS, Scranton, Pa., were recently visited by fifty of their representatives, some of whom came from as far away as Portland, Me., and Winnipeg, Manitoba.

THE ELECTRIC APPLIANCE COMPANY, Chicago, owns the factory making "Crystal Lake" cross-arms, pins and brackets. This company claims, therefore, to be in a better position than other western supply houses for making prompt and satisfactory shipments.

WOODS, WARING & COMPANY, 21 Van Buren street, Chicago, is placing on the market a line of electromobiles from the designs of Mr. Clinton E. Woods, who is well known in the automobile field. This company has just completed a new catalogue, which it will be pleased to send to applicants.

D. L. BATES & BROTHER, Dayton, Ohio, are mailing their calendar for the current year. On the face of the card upon which the calendar is mounted appears a photogravure of two handsome dogs, while the back of the card contains the company's price list for January 1, making all previous lists void.

THE EMERSON ELECTRIC MANUFACTURING COMPANY, St. Louis, Mo., has issued an attractive brochure of 50 pages under the title of "That Devil Doubt." The contents of the book are testimonials for that company's desk and ceiling fans and alternating-current motors. The cover is attractively designed in slate and gray.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is mailing a folder illustrating the good points of its graphite products, pencils, crucibles, etc. It is presented as an "old friend in a new dress," and is stated to be particularly valuable to any one interested in lubrication. The company will be pleased to send it to any one interested, and it is well worth the reading.

THE COLONIAL ELECTRIC COMPANY, Ravenna, Ohio, is mailing a handsome calendar for 1901. The calendar is mounted upon heavy tinted board, and bears on its upper end a photogravure of excellent finish and quality. The product of the Colonial company—Orient and Colonial incandescent lamps—is too well known to need any further description here, and the company reports that the market is active.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., has issued its circular No. 62, regarding the application of storage batteries to lighting and power stations, particularly those of medium size. The contents of the folder are from the paper read by Superintendent L. G. White, of the Columbus Edison Electric Light Company, before the Ohio Electric Light Association at Toledo on August 15, 1900. Seven cuts illustrate the folder.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., is mailing its illustrated sectional catalogue No. 118 regarding the company's A. B. C. system of mechanical draft, forced and induced by blowers and exhaust fans. The pamphlet is handsomely gotten up and contains full particulars of the company's machinery besides valuable tables and engravings of plants where the machinery is installed. It will be mailed upon application to any one interested.

THE COLUMBIA INCANDESCENT LAMP COMPANY, St. Louis, Mo., is daily turning out large quantities of its well-known lamps, the demand for which is said to be increasing with every month. This company's standard is perfection, and it claims that no lamp is permitted to leave the factory until the tests have proven it to fulfill in every particular the claims made for it. A trial order of a barrel of Columbia incandescents will convince the most unfriendly of their economy, merit, and general utility.

No. 15 OF THE "FOUR TRACK SERIES" of the New York Central & Hudson River Railroad Company is a handsome folder devoted to the Pan-American Express, and containing much matter of interest regarding the coming exposition at Buffalo. The Pan-American express leaves New York daily at 8 P. M., arriving at Buffalo at 7.25 A. M. the next day. Copies will be mailed to any one interested on application to Mr. George H. Daniels, general passenger agent, Grand Central Station, New York, N. Y.

THE AMERICAN BRIDGE COMPANY, New York, has the contract for about 20 bridges for the Erie Railroad Company, 2,800 tons of structural steel for the Kingsbridge Road power-house on the Third Avenue Railroad, New York, and all the steel work for the large building to be erected by the Montezuma Copper Company at Nacozani, Mexico. The American company also announces that its sales during the month of January were the largest of any month since the organization of the company, aggregating over 60,000 tons.

THE AMERICAN ENDOSCOPIC COMPANY, Providence, R. I., is mailing neat blotters illustrative of its electrical window display signs. The principle of the sign is a rim in which are sunk sockets for incandescent lamps, the whole being wired with flexible cord which has a plug attached to it admitting of connection anywhere the owner chooses to place it. The lamps on the signs are in series, and take Edison, Westinghouse or Thomson-Houston plugs, running from four to twenty lamps to each sign. Five three-candle-power lamps can be run in series on 50 to 60 volts, 20 lamps to each sign; and three five-candle-power lamps on 100 to 110 volts, with 18 lamps to each sign.

THE CONSOLIDATED RAILWAY ELECTRIC LIGHTING AND EQUIPMENT COMPANY, New York, is in receipt of a number of compliments upon the success of its train lighting system. In this system the current is generated from the car axle while the car is in motion, and supplied by storage batteries when the car is stationary. Each car carries its own lighting apparatus and the cost of maintenance is claimed to be very small. Recently a limited train between Los Angeles and San Francisco was blockaded in the San Joaquin Valley on account of a severe rain storm and the train, consisting of four cars, laid up for three days and three nights. The train was lighted throughout by the Equipment company's system and the lights were in constant use. They held up in fine shape throughout the entire period. The cars running on this line lighted by this system are greatly pleasing the railroad men as well as the passengers.

I. P. FRINK, 551 Pearl street, New York, has just completed the installation of lighting fixtures for the Second Church of Christ, Sixty-eighth street and Central Park West, New York city. This church is almost entirely lighted by concealed lamps backed by powerful reflectors that throw all the light upon the large domed ceiling, which again reflects and diffuses the light all over the church. The Frink name has been identified for nearly half a century with successful church lighting by reflecting chandeliers and prismatic sun-lights, but this method as applied to churches is comparatively new, though it has been most successfully used in fine ball rooms, concert halls, banquetting rooms, etc., where a soft and perfectly diffused, but at the same time strong light is required by the scheme of decorations. Mr. George Frink Spencer, manager of the Frink business, who has made a specialty of this method of lighting, has been frequently consulted by leading architects and electrical engineers, and has been commissioned to devise and execute the fixtures for some of the finest interiors in New York.

THE SHELBY ELECTRIC COMPANY, Shelby, Ohio, is mailing one of the most unique advertisements gotten out for a long time to illustrate the efficiency of incandescent lamps. Four small cards, each bearing an incandescent lamp, are mounted upon a large card, and so fixed that they can be revolved. Underneath each small card is an arc of 180 degrees, running from zero on either side to 90 degrees in the centre. On the cards the incandescent lamps are shown with lines radiating from the filaments giving the candle-power units at different angles, while on the back of the large card is an offer of $10 in gold to the first person who writes the company stating the position in which Shelby lamps can be placed so that they will not deliver more light in useful directions than lamps of other makes in the same position. In addition to the above offer, $10 gold is offered to the person first telling the company a good reason why Shelby lamps should not be used, and $5 will be sent to each first person of two classes telling the greatest number of advantages Shelby lamps have over other makes, and the advantages that other makes have over the Shelby lamp.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, Cincinnati, Ohio, during the week ending February 2, booked the sales which follow, and at the same time issued its Bulletin No. 38, describing electric locomotives and crane cars. The bulletin will be cheerfully mailed upon application to the company.

Joseph Joseph, Cincinnati, Ohio, one 50-kilowatt, engine type.

Manning, Maxwell & Moore, New York, one 180-kilowatt, engine type generator; one 35, one 50 and one 65-horse-power motors.

Pittsburgh Engineering Company, Pittsburgh, Pa., one 30-kilowatt, engine type.

American Sugar Refining Company, New York, one 50-horse-power motor.

John L. Thompson, Est., Baltimore, Md., one 100-kilowatt, engine type generator.

The New Schuyler Apartments, one 50-kilowatt and one 25-kilowatt, engine type generators.

Fore River Engine Company, Quincy, Mass., 14 motors of miscellaneous sizes. This makes about 40 Bullock motors in all which this company has purchased.

United States Finishing Company, Greenwich, Ct., one 75-horse-power motor.

Mosler Safe Company, Hamilton, Ohio, one 35-horse-power motor.

Pacific Coast Borax Company, Bayonne, N. J., one 15-horse-power motor. This makes about 20 Bullock motors now in operation by this company.

Wolf Process Lea. Company, Summerdale, Pa., one machine, 80-kilowatt, engine type.

Jacob Ruppert, New York, two machines, 60-kilowatt generators, engine type and switchboard, together with several small motors.

National Enameling and Stamping Company, Baltimore, Md., one 65-horse-power motor.

Christian College, Columbia, Mo., one 17½-kilowatt, engine type generator.

Bergtheil & Young, London, England, one 225-kilowatt, type "H" generator, and two 60-horse-power Teaser equipments for operating newspaper press.

Brown Hoisting and Conveying Company, Cleveland, Ohio, one 25-horse-power motor.

Columbia Chemical Company, Barberton, Ohio, one 42½-kilowatt, engine type generator.